GAMIFICATION OF EDUCATION: USING BADGES IN AN E-LEARNING COURSE TO DEVELOP REWARD ORIENTED ACTIVITIES AND IMPROVE LEARNING EXPERIENCE

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INTRODUCTION

Education has been a subject of study to modern society and much work has been applied to make it available and applicable to everyone. Traditional pedagogies rely on blackboards, oral lectures, books and written exercises as the main method to hand down information. However, current pedagogies are not efficient or effective enough to instill motivation in students as shown in the decreasing trend of academic motivation for the past decade (Janae, 2017; Luna 2015).

Student motivation has, for some time, been described as one of the foremost problems in education. It is certainly one of the difficulties most commonly cited by teachers. Motivation is important because it contributes to achievement, but it is also important itself as an outcome (Ames, 1990).

However, through the years our technology brought new possibilities to teach and educate, such as using game elements which spiced up curiosity and fired discussions amongst many educators and researchers. Unlike traditional educational methods, games can hand down knowledge on demand and within context. Well implemented games are designed to be challenging enough to stop players from getting bored or frustrated, thus allowing them a flowing experience of things (Deterding *et al.*, 2011; Barata *et al.*, 2013a).

As games are seen as something that gives so much motivation, they are currently explored in many non-game contexts through what is commonly termed as gamification.

There are design of gamification that focuses on the emotion rather than the mechanics of the gamified service to cater people that believes that emotion is the key. Gamification uses game elements to non-game services, rather than using full-fledged games. The boosting interest in Gamification is shown in research materials: the quantity of papers published on Gamification is really growing (Huotari and Hamari, 2012; Robson *et al.*, 2015).

Badges have been the most common game element mechanics used in Gamification. It is being studied in many contexts. Badges consist of optional rewards and goals, the fulfilment of which is located outside the scope of the core activities of a service (Gibson *et al.*, 2015). On a systematic level, a badge consists of a signifying element (the visual and textual cues of the badge), rewards (the earned badge), and the conditions to fulfill to determine how the badge can be earned. Furthermore, because of the visual elements of the badges and the included descriptions regarding the goal and how to unlock a badge, have been found to give rise to intrinsic motivations (Dichev and Dicheva, 2017).

Cialdini's Social proof theory implies that people are engaging more in activities which they see others are also engaging with it. Badges induces phenomena of the social proof theory by constructing a means for individuals to observe the behavior of others, and indicating which activities they have been to get some rewards. As stated by Cialdini, "We view a behaviour as correct in a given situation to the degree that we see others performing it." (Rosenthal and McKeown, 2016).

The other side of this theory is social validation, by which people signal their conformity, in that they have also engaged in same behaviours. It was found that people were willing to pay up to 64% more for a product that their peers had already acquired. Badges facilitate social validation by providing a means for users to display their conformity to the behaviour and expectations of others (Hamari, 2017).

Objective of the Study

The study will focus on the following objectives:

- Make an effective badge mechanic in a learning course to increase their engagement because of the rewards and social validation.
- Provide a badge framework that is effective in increasing the learning experience of students in their courses.

Significance of the Study

There are so many pedagogies that aim to increase student motivation that affects the factors of learning (Luna, 2015). One way is Gamification, having game-like elements in a college course can benefit significant areas. Badges may give intrinsic motivation and increase user-activity in this study entitled 'Gamification of Education: Using Badges to Increase Student's User Activity and Performance' was conducted for the benefits of:

Professors. Teachers may gain new knowledge of this Gamification as a pedagogical aid. It will help solving the problem of student's motivation as it is one of the most commonly cited by teachers (Ames, 1990).

Students. As the immersion increases the gameful experience contributes to their learning. It will allow them to find and engage new learning experience. Badges will

allow students to have clear goals and may make them collect badges. It gives intrinsic motivation where they see badges as collectibles, rewards, and proof of their achievements (Barata *et al.*, 2013a).

Scope and Limitation

The study mainly focuses on the effect of badges towards the motivation and user activity of students in with respect to the system. The target users would be the students of University of the Philippines Mindanao specifically CMSC128 will be the testers of the said application. Results may vary as survey will be used as a core metric for this research. With limited time of 3 months of data as a time constraint of the research.

REVIEW OF LITERATURE

Application of badges

People like to collect trophies or other collections as to display it. For this reason, providing a virtual space where e-learners can display their hard-earned badges would be a good idea (Jacobs, 2017). A badge should follow the three main concept to make it effective. First a signifier. It is composed of the visual, name, and description. The second one is the completion logic. It is composed of the conditions or the pre-defined amount of actions. The default reward is the badge and it could be mixed with other game elements (Li, Huang and Cavusoglu, 2012; Gibson *et al.*, 2015; Hamari, 2017). They could be an open list of badges as users could get all the badges in a dynamic manner. It could be linear as you could get badges of higher degree by getting lower degree badges first. There are many styles of badge application as to how the developers decide for a service. Also gamification that is project base are included here, the application of outside scope where learners try to solve world problems through project applying the information that they may learn from a course (Janae, 2017).

Badges

Badges were used already in traditional pedagogy. The used mechanic was lacking to motivate students. The badges used are in the form of ribbons. The teachers did not set clear goals of how to attain it. It is one of the reasons that lacks the participant to get motivated to earn those ribbons whether extrinsic or intrinsic. This shows that traditional methods was already gamified yet failed to achieve the mechanics that will motivate students (Lee *et al.*, 2011; Alexe, Zaharescu and Apostol, 2013). Badges though could be in different forms such as digital badges.

Digital Badges. A digital badge is a representation of an accomplishment, interest or affiliation that is visual, available online, and contains metadata including links that help explain the context, meaning, process and result of an activity (Gibson *et al.*, 2015). Badges are seen to be common stimulators of intrinsic motivation as it gives directly the idea of your goals, a sense of freedom, and rewards. Badges do not strictly follow the context and goal of the main system, it may give users reasons to be more active by giving badges when they are more active. Giving more bonuses when a user is more active gives intrinsic motivation to users since they may want to collect the badges or earn rewards (Hamari, 2017).

Digital badges also provide new affordances for online educational activities and experiences. When used with points and leader boards, a badge can become a gamification element allowing learners to compete with themselves or others, and to know how close they are to accomplishing a goal and acquiring its accompanying reputation. In this role, badges motivate continued engagement, which increases time on task and supports skill acquisition through performance. Learning outcomes signified by badges can also be displayed in an e-portfolio or on web sites and are highly transportable to social media sites. In this role they summarize achievement and signal accomplishment.

Comparison of digital badges. Another stimulator of intrinsic motivation is the comparison of badges. Social Proof theory complements the implication that badges gives intrinsic motivation to people. It states that people are more likely to engage into something that people have been engaging with. It gives them assurance that those activities are good since many engaged in it and it seems promising. Making a space to view other people's

badges encourages them to collect them as proof of their achievements. (Botha, Herselman and Ford, 2014)

With these characteristics, digital badges have the potential to become an alternative credentialing system, providing visible recognition in digital symbols that link directly via metadata to validating evidence of educational achievements in public displays.

E-Learning

E-learning systems are computer-based systems that uses the web or applications that may or may not use the internet to give learning information for the users. E-learning is effective because of its portability, visuals, and audio (Articulate, 2015). It was called E-learning by the Instructional Technology Council as well as the National Center for Education Statistics as the process of extending learning or delivering instructional materials to remote sites via the Internet, intranet/extranet, audio, video, satellite broadcast, interactive TV, and CD-ROM. (Muntean, 2011)

E-learning sprinted its growth through 1990s, most E-learning consisted of Flash versions of PowerPoint presentations. Well they can be millions of E-learning branches as E-learning is education or training delivered electronically (Kim and Frick, 2011)**.**

The Internet has brought dramatic changes to education as well. As of 2003, 100% of public schools in the U.S. had Internet access, up from 98% in 2000. Ninety percent of public schools offered Internet courses using asynchronous computer-based instruction. Eighty-eight percent of public schools indicated plans to start or increase use of the Internet as a primary mode of instructional delivery (Lee-Post, 2009)

The growth of distance learning is phenomenal when comparing the 1997-1998 statistics with those of 2000-2001:

- A 14% increase of the nation's public 4-year institutions offered distance learning courses (from 78% in 1997-98 to 89% in 2000-01);
- A 123% increase in enrolments in college-level, credit-granting distance learning courses (from 1.3 million in 1997-1998 to 2.9 million in 2000-2001; with 82% of the 2.9 million at the undergraduate level in 2000-2001);
- A 45% increase in the percentage of institutions using asynchronous Internet-based technologies as the most used distance learning technologies (from 60% in 1997-98 to 87% in 2000-01).

The following information gives a strong evidence that education has been changing from the traditional methods as to adapting a new way of delivering knowledge through E-learning. With this many E-learning model

E-Learning model

There are many e-learning models as to fit for the needs of the service. Though E-learning is growing it needs to have some standards to deliver the quality service needed for the learning processes (Bauk, Šćepanović and Kopp, 2014). It was shown that past studies suggest that lack of time and lack of motivation are primary causes of learner attrition in online settings (Kim and Frick, 2011). Thus making a model that encourages motivation.

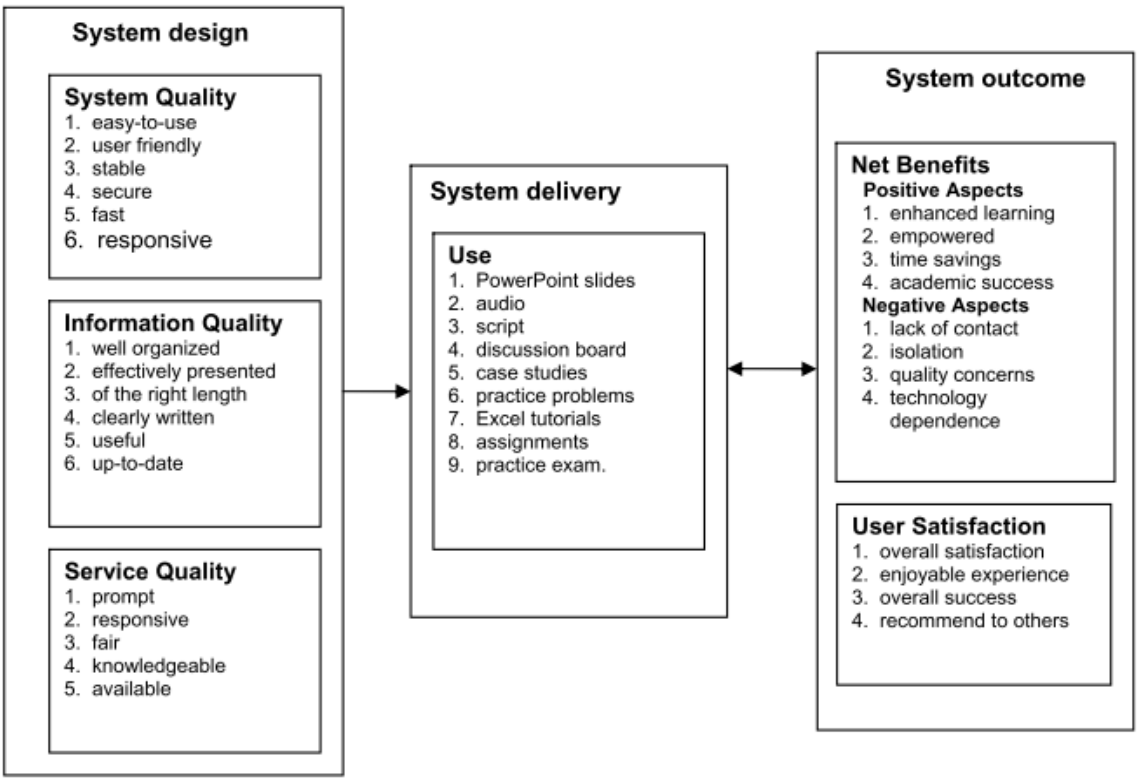

Fig. 1. Lee-Post E-learning success model.

An e-learning success model derived and adapted from DeLone and McLean's information systems success model ensures the quality service of an e-learning (Halonen *et al.*, 2009). It was compiled from past literature on information systems success, six dimensions of success factors, namely, system quality, information quality, service quality, use, user satisfaction, and net benefit, are identified and incorporated into an overall success model (Lee-Post, 2009). In Fig. 1 the model is shown how it works with its structure.

The model in Fig. 6 gives a certain success metrics that is useful for gamification and e-learning contexts. The process approach see to it that the overall success of the e-learning depends on the attainment of success at each of the three stages of e-learning systems

development: design, delivery, and outcome analysis to cover everything. The arrows in the Fig. 6 shows the interdependence of the corresponding pointers. System outcome and System delivery affects each other given a one way impact of the system design towards them (Lee-Post, 2009).

This kind of content structure can allow us to visualize gamifying education by e-learning models (Muntean, 2011).

Gamification

Gamification is the application of game-elements in a non-game context. Game elements such as leader boards, badges, rewards, etc. (Jackson, 2017). It does not need to make a service to be a game, but to implement the benefits and the impact of such game mechanics to non-game services to partake the positive effects of elements such as competition, motivation, and engagement. Gamification has been recently studied and being applied to many fields including Commerce, Education, Business, Trading, and Q&A services (Huotari and Hamari, 2012).

Gamification is quite a new concept, on the market as well as in research, but it has a big potential. It has been added to the Gartner Hype Cycle for 2011 showed in Fig. 2. Gartner predicts gamification will be a key trend that every IT planner and enterprise architect must be aware of as it relates to business. Fig. 2 shows Garner Hype Cycle.

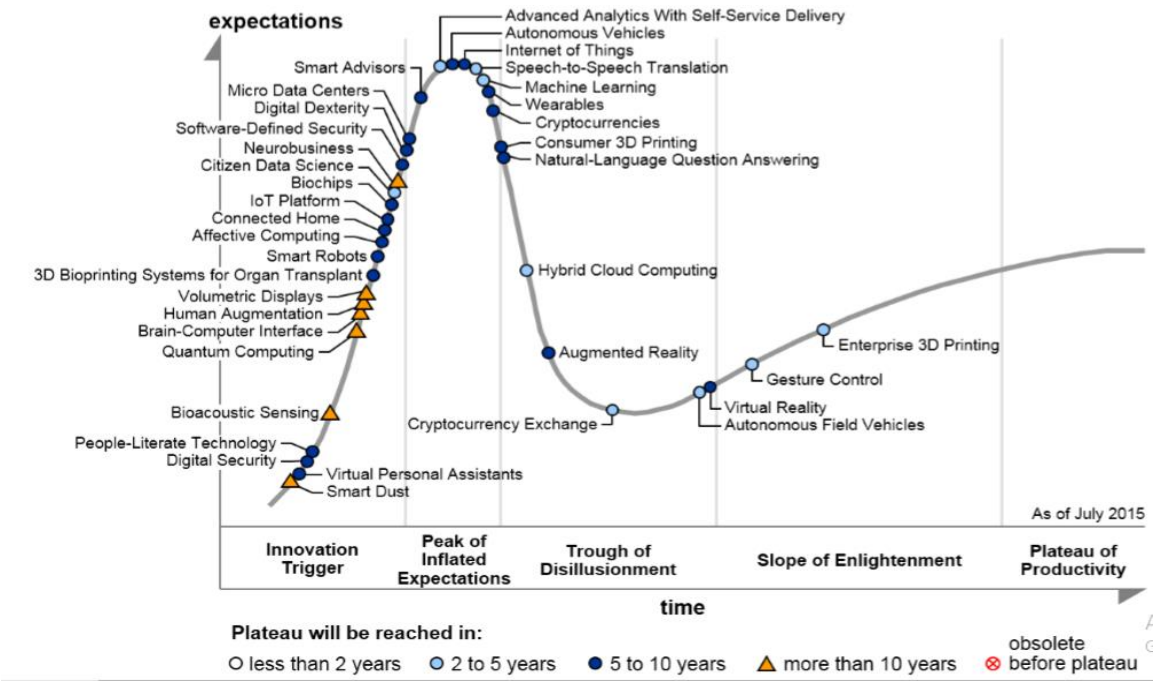

Fig. 2. Gartner's Hype Cycle

Gamification of education is a developing approach for increasing learners' motivation and engagement by incorporating game design elements in educational environments. It does not imply creating a game, Gamification makes education more fun and engaging, without undermining its credibility. Gamification helps students gain motivation towards studying, and because of the positive feedback they get pushed forwards and become more interested and stimulated to learn. Gamification can give a great boost to determine them to study/read more (Glover, 2013).

Gartner hype cycle. It is a recommender and depicter, a graphical representation and depiction of technologies as to how they arise. It is a way of clients to track down or find out the technologies maturity and future potentials (Fenn and Linden, 2003).

Features of a game

The definition of gamification above stated that it uses game elements or features to the learning process. Features of games or the game elements that gamification uses are the core items that which a game revolves and makes it interesting. The following elements that will be used for the system will be introduced briefly as to what they are and how they are being used.

Badges. These are common game elements used in various contexts. Badges are already used in traditional pedagogies, yet lacks the attributes to be effective (Lee *et al.*, 2011). Badges are made up of a signifying element, a visual for the badge; like ribbons or medals. It has the reward of the badge itself or more, a goal set as to how to attain a certain badge, and the badge itself becomes the proof of the engaged activity. It focuses on the intrinsic motivation of people, engagement, and may also foster competition (Janae, 2017).

Leaderboard. Leaderboard is the game element that focuses on tracking down the results of different people for the comparison of their performances. It tallies down the top scorer of a certain activity. It is the best game-element to foster competition whether be friendly or not. It is designed differently as to how the developers want a Leader Board mechanic that will reach their objectives (Huang and Hew, 2015).

Progress bars/Progress graph. Progress graphs is the individual graphics of individual's progress. It is the tracking down of an one's work load over time. It gives a comparison of how you spent your time and how well you did on certain activities. Progress bars are often shown as private to individual users. It gives them continuous feedback and the message that they are heading in the correct direction (Harrison *et al.*, 2007). It might

be good to use progress indicators, in the form of a progress bar or other percentage-completion indicator, to show learners how far along they are in each task then.

Reward system. Reward system is a game element that could be with others as it complements it. Rewards could be mixed with badges and Leader Boards. It could be an additional reward for getting or completing the set goal of a certain badge, or a reward as getting a top score of a certain activity. Rewards are very simple yet very effective. It gives users delight and surprises such as giving them unannounced gifts. It leans to intrinsic but more on the extrinsic motivation of users that boosts engagement and productivity (Barata *et al.*, 2013b).

Process of gamification

Gamification can be applied in many ways but there is a given literature where it shows a reviewed way on how to gamify services. There are seven main steps in gamifying a certain service according to Morschheuser (Morschheuser *et al.*, 2017).

Project preparation. Project preparation is the first process mentioned in gamifying. Eleven gamified methods in some reviews recommended to start with the identification of the problems to be addressed through gamification (Morschheuser *et al.*, 2017). The project planning includes the objectives and project variables. List of Objectives ordered by their rank being justified is also important. Then assessment if gamification is applicable, deciding whether the project is legal and ethical, budget intact, timely, etc. Preparation to visualize the overall outcome should be considered to see to it the success of the plan (Herzig *et al.*, 2015).

Analysis. Analysis of context and users is given as the second for gamifying. It is important to study the target group, as well as the characteristics of the system that should be gamified (de Sousa Borges *et al.*, 2014). These includes some interviews, observations, measurements of actual user behaviour, analysing behaviour chains, surveys, and focus groups. Once an encompassing overview about user and context characteristics has been gathered, the next step is to develop a gamification design (Morschheuser *et al.*, 2017).

Ideation. Most of the identified literature of the gamification designs specifically includes challenges that are engaging using the patterns from known form games. Deciding what game elements to use: Leader Boards, Badges, Progress Bars, Reward Systems, etc. (Deterding, 2015). Activities of this phase includes brainstorming of ideas, consolidate ideas, and listing the ideas. It may tackle the fulfilment of user's need, desired behaviour and target outcome, rather than on technology or game elements (Huotari and Hamari, 2012).

Frameworks are related to the Ideation of gamification. Frameworks are used such as the User-Centered Design framework (Nicholson and Studies, 2012), Design Thinking , the Octalysis Framework (Landsell, 2016), the Playful Experience framework (Holopainen *et al.*, 2013), Lazzaro's 4 keys of fun or the Person-Artifact-Task (PAT) model in order to guide the ideation (Morschheuser *et al.*, 2017)**.**

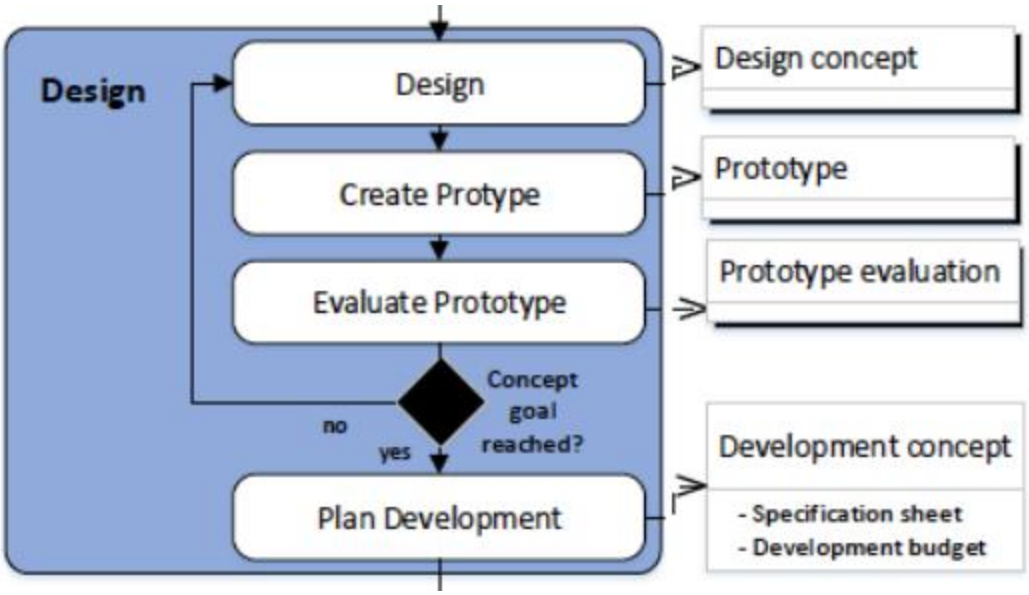

Fig. 3. Application of Gamification Design Flow

Design. After gathering a lot of information and ideas, a concrete and detailed gamification design can be developed. Ideation phase is strongly related to this part as to how it contributes the ideas for the final design. Literatures recommended the rapid development of prototypes, sketches or wireframes to continuously test the improvement and success of the designed idea. A design flow in Fig. 3 showing how design stage works.

Implementation of Design. The implementation of design starts as to how and who will implement the design. Experts say that they build their own team for the implementation of the concrete design (Morschheuser *et al.*, 2017). The implementation revolves in a cycle of continuous testing usually called Alpha testing as the developers continues to work on the design. An implementation design flow is shown in Fig. 4.

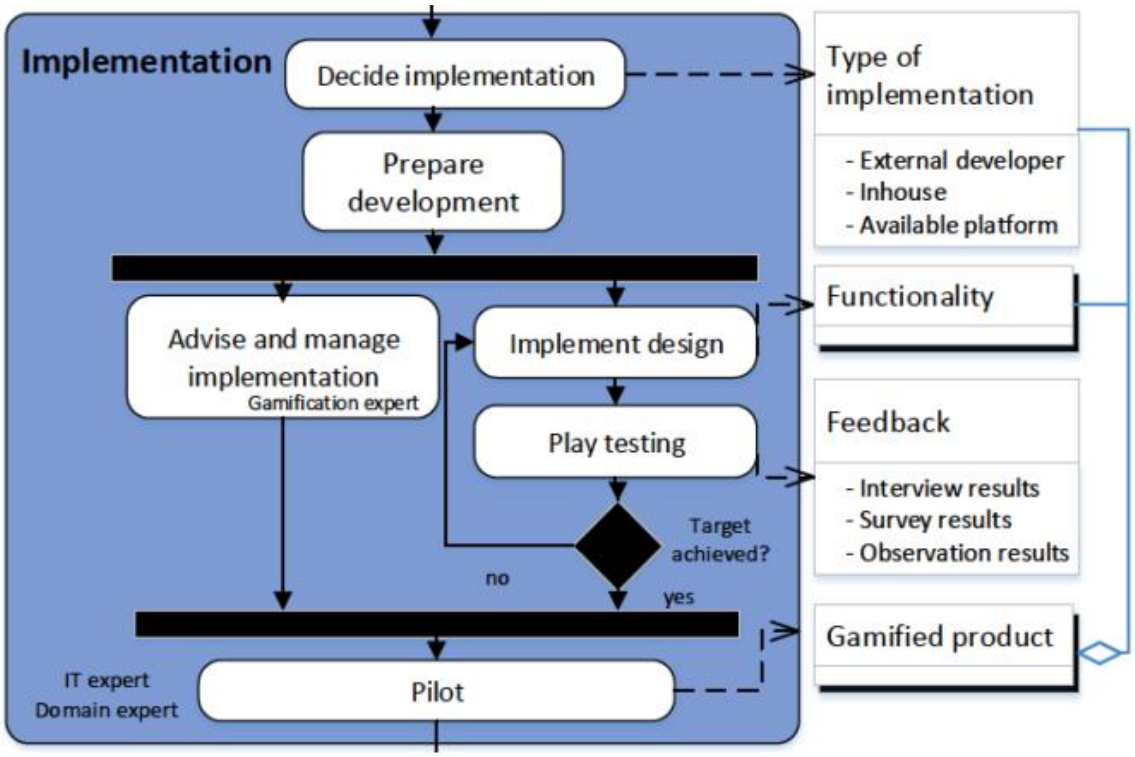

Fig. 4. Application of Gamification Implementation Flow

Evaluation. After the implementation comes the observation as if the design meets the standards, and defined objectives. Quantitative and qualitative approaches could be used for the evaluation of the design. Then the results are gathered to be analysed.

Monitoring. Some articles see gamification as a cycle of iterative pattern of design, development, evaluation, monitoring and adaptation, etc. Most reviewed materials have largely omitted this aspect. In Fig. 5 is a monitoring flow diagram showing how it works.

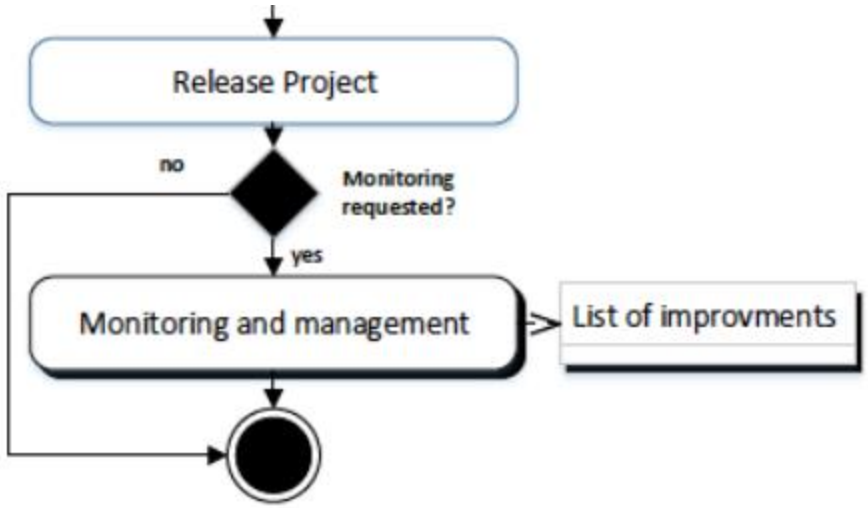

Fig. 5. Application of Gamification Monitoring Flow

However, more than half of the experts emphasize that gamification projects should not be considered as typical deterministic software projects. “A successful gamification project should never end, because it will become part of how the organization works” (Jacobs, 2017). Most experts recommend a monitoring phase; in which the system usage is investigated in regular intervals. Fig. 5 showed the flow of the monitoring phase

Self Determination Theory (SDT)

SDT is an approach to understand human’s personality and self-regulation. All the intrinsic resources of man that may involve self-motivation and other aspects that produces positivity are examples of subjects that SDT could be applied (Gagné and Deci, 2005). It was found that there is a need for competence, relatedness, and autonomy - that appeared to be necessary for connection and growth, as well as for constructive social development and personal well-being to intrinsic motivation (Ryan and Deci, 2000).

Autonomy. As shown in Maslow's model in Fig. 6, autonomy belongs to the most important intrinsic motivators and on the top of the hierarchy of needs. It talks about the determination of a person how to complete a task. They may be given the goal or how to complete the task. Autonomy talks about the ways of how a person determines how to achieve those goals, not limiting them to rigid instructions that is the only way to complete an activity (Ryan and Deci, 2000; Gagné and Deci, 2005; Mahadar and Technology Solutions, 2014).

Much of the research guided by SDT has also examined environmental factors that hinder or undermine self- motivation, social functioning, and personal well-being. Although many harmful effects have been explored, Kanfer's study suggests that these disadvantages can be most simply described in terms of competence, relatedness, and autonomy. Thus, SDT is concerned not only with the specific nature of positive developmental tendencies, but it also examines social environments that are antagonistic toward these tendencies (Kanfer, Frese and Johnson, 2017).

The use of experimental paradigms has allowed researchers to specify the conditions under which people's natural activity and constructiveness will flourish, as well as those that promote a lack of self-motivation and social integration (Kanfer, Frese and Johnson, 2017). Self-Determination theory gives importance to the autonomy of humans that e-learning was able to contribute to as shown by the growth of distance learning courses (Lee-Post, 2009). In Fig. 6 a diagram showing a theory of human motivation constructed by Maslow (Mahadar and Technology Solutions, 2014). This SDT also explains and contributes to the knowledge of motivation.

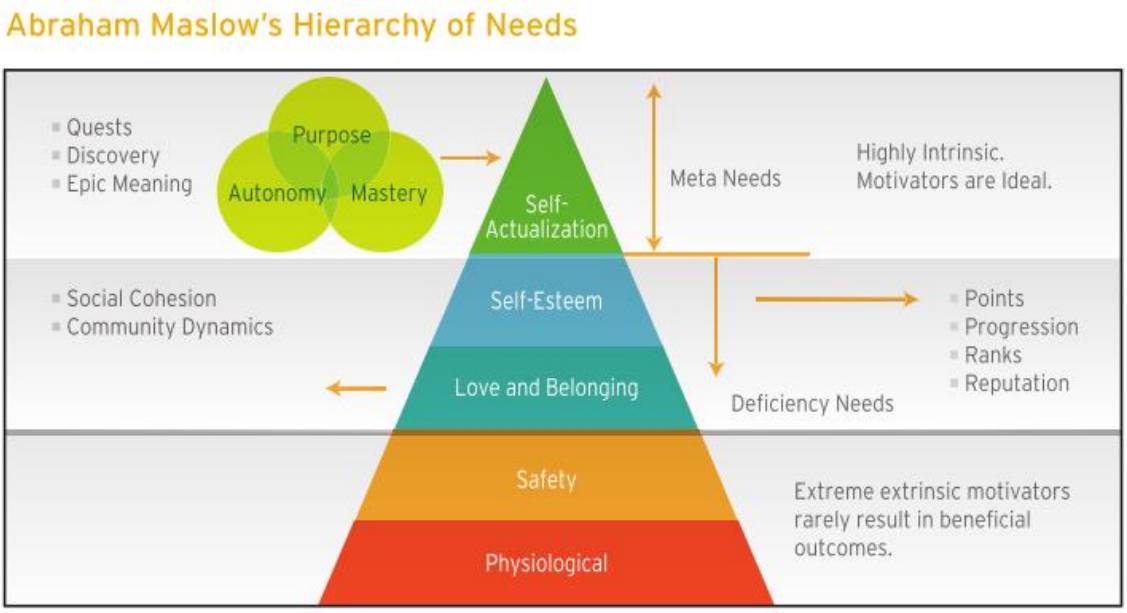

Fig. 6. Abraham Maslow's theory of human motivation

The Nature of Motivation

Motivation deals most of the things that takes as a factor of our decisions whether a trigger or a cause. It is one of the main concerns in the field of psychology that has been perennial to many aspects of other fields from cognitive to biology (Gagné and Deci, 2005). Researches shows that individual activity and performance of students are significantly affected by motivation. Because motivation offers several benefits, it is highly valued and regarded in the real world which makes motivation one of the main concerns of everyone that involves groups and crowd of people. However, it is not to be confused with engagement (Ryan and Deci, 2000).

Engagement, on the other hand, is a behaviour where people tries to be more active and into the services of a certain activity or group. Engagement behaviour still being affected of an individual's motivational factors (Li, Huang and Cavusoglu, 2012).

Although motivation is often treated as a singular idea, even the pondering and reflections through our course of actions is being varied to many factors not being fully understood. It may result that people do a certain action because of own willingness to do so or a strong external coercion as a cause. They can be urged into action by an abiding interest or by a bribe. They can behave from a sense of personal commitment to excel or from fear of being shrivelled (de Sousa Borges *et al.*, 2014).

Hence, motivation can be categorized into two: intrinsic and extrinsic motivation. Intrinsic motivation occurs when one's determination is obtained from self-deduction through one's own realizations, observations, and ideas.

Extrinsic motivation, on the other hand, occur when something or someone determines the user to make an action (Kim and Frick, 2011). These contrasts between cases of having internal motivation versus being externally pressured are surely familiar to everyone. The issue of whether people stand behind a behaviour out of their interests and values, or do it for reasons external to the self, is a matter of significance in every culture and represents a basic dimension by which people make sense of their own and others' behaviour (Ryan and Deci, 2000).

Intrinsic motivation. Intrinsic motivation, the prototypic manifestation of the human tendency toward learning and creativity. There are no procedures or any phenomena that reflects the positive potential of humans as much as intrinsic motivation, the inside tendency to wonder and find novelty and challenges, to improve one's skills, to adventure, and to learn (Gagné and Deci, 2005).

According to Self Determination Theory, people have the tendency to pursue activities that offer intrinsic motivational needs such as competence, relatedness, and autonomy. Some studies suggests that intrinsic motivation obtained from games is derived from its ability to satisfy basic psychological needs (Ryan and Deci, 2000).

Extrinsic motivation. Extrinsic motivation occurs when the drive to engage in an activity derived from an external source. It is implied in the Self Determination Theory that extrinsic motivation can be internalized by an individual if the task fits their values and beliefs which would satisfy their psychological needs, hence, enhances their intrinsic motivation (Li, Huang and Cavusoglu, 2012).

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MATERIALS AND METHODS

Requirement Phase

Angular

Angular is a front-end development framework developed by Google. It is popular due to its high performance among single page sites. It focuses on the web designs not necessarily web developers but web designers that will aid them have a nice framework. It can be deployed through many platforms ios, android, web browsers, mobile web, and desktops. Others even used this for virtual realities. (What is Angular? n.d.)

Balsamiq Mockups 3

This is a mock-up tool for making designs for websites and applications (Balsamiq Mockups 3 Application Overview n.d.). The researchers will use this software to generate digital sketches of the modules that they want to implement. These designs will serve as the researchers guide for the structure of the site.

Bootstrap

This is a front-end component library used to build responsive, mobile-first projects on the web. This makes front-end web developing faster and easier (Bootstrap n.d.).

Express

Express is mainly a server sided framework. It is an Model-View-Controller architecture, it is mainly for making it easier in the server side. It is more popular for routing and for its middleware for connection. (node.js – What is Express.js? – Stack Overflow n.d.).

GitLab

GitLab is an open-source application used for version control. It is widely used by data analyst and developers. It is a management tool for advancing, merging, updating, deleting, and back-up for files and data. (GitLab Inc. n.d., Git n.d.).

Web browsers

Web browsers will be used by the researchers for the development of the system. Such browser like Google Chrome, Edge, and Mozilla will aid the development for its debugging tools.

MongoDB

MongoDB is a database structured as documents not in tables. It is an object oriented collection with documents shown as JSON. (What is MongoDB? n.d.).

Node.js

Node.js is good for handling speed and performance. It is an asynchronous framework for the server side. It is also light-weight and efficient as it uses an event-driven, non-blocking I/O model. (About Node.js n.d., About The Node.js Foundation n.d.).

Visual Studio Code

Also known as VS Code, this is a simple source code editor combined with a powerful developer tooling. VS Code runs on macOS, Linux, and Windows so developers can freely work no matter the platform (Why did we build Visual Studio Code? n.d.). This is to be used by the researchers as it will allow a git synchronization. It is a great IDE for developing the system.

System requirements (minimum)

Listed below are the minimum system requirements for the development of the system:

- Storage: 100 Gb
- RAM: 2 Gb
- CPU Cores: dual core
- Operating system: Windows 7 (with .NET Framework 4.5.2), 8.0, 8.1, and 10 (32-bit and 64-bit)

Design Phase

Visual Studio Code will be used as the main integrated development environment (IDE) for the programming part. For version handling of the projects, Git Hub will be used for easy integration during the system development. Angular will be employed as the front-end framework for the e-learning system.

Angular offers many features including Ahead of Time (AOT) compiling that will enhance run time for a system. Node JS will be used as an executer of source codes. The proponents will be using a single database for the whole system that will be shared by all the modules. Usability test, Survey questions, and activity logs of the system will be the data to be analyzed for the research.

The server-side framework to be used along with Angular is NodeJS and ExpressJS. NodeJS is an open source, cross-platform server framework for easily building fast and scalable network applications while ExpressJS is a NodeJS web-application framework.

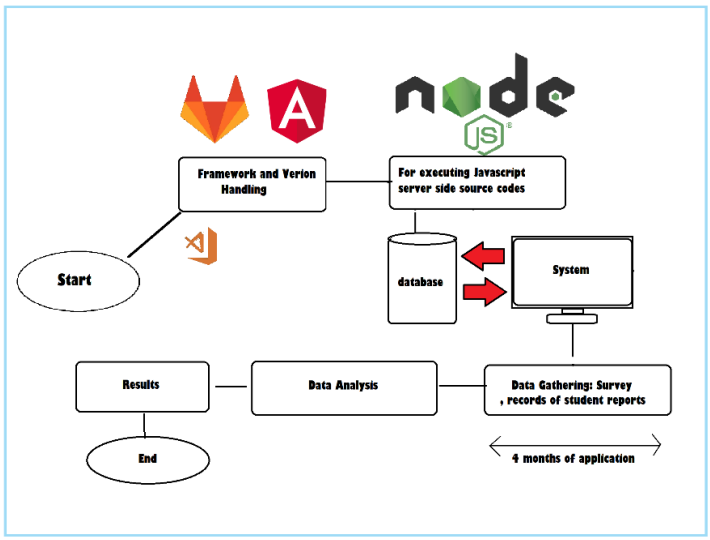

Fig. 7. Project flow diagram.

In Figure 7 the project flow diagram for the system shows how these tools are used for the design phase of the development.

Conceptual Framework Diagram

There will be two main modules for the system, the student and the teacher module. In Figure 8 a conceptual framework diagram showing the interaction of the two main module is shown. The main components are the users, system, and the Mongo DB database.

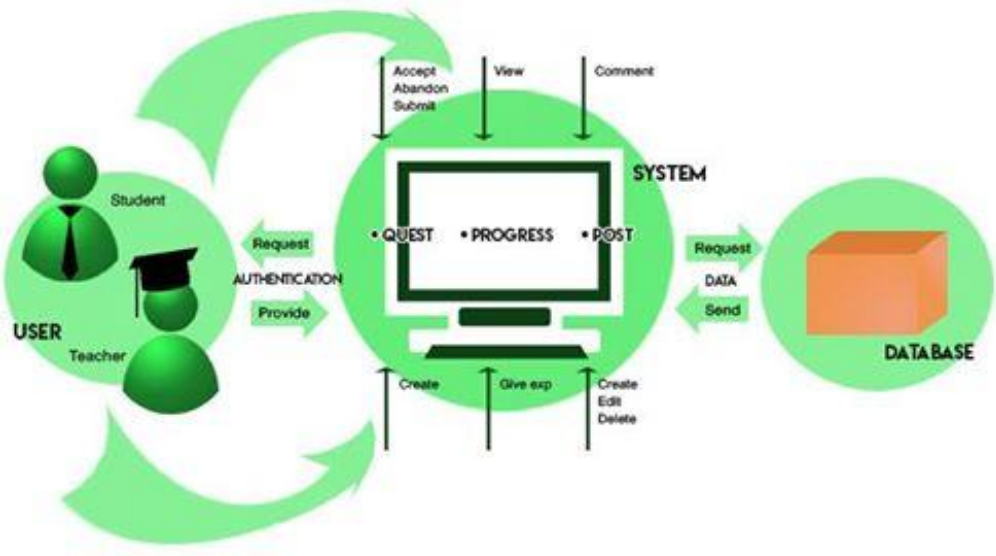

Fig. 8. Conceptual Framework Diagram of the gamified system.

The User defines both the students and teachers. There will be a course to be shared by both users for their shared courses. This will be the interaction of the teachers and the students in the system. Teachers give the students quests in their courses. Students take these quests as equivalence to their grades. They can choose many quest to take and can also abandon them. The gamification elements will also aid them in their learning experience as it will be shown in the system's user interface. The badges, leaderboards, progress reports, and rewards.

The database will store all the data from the user requests. New data can be stored, and the existing data could be updated, depending on the authority of the user type. The system will use the database for loading the needed information as you enter the website. It will serve the request and will return a response for the requesters. The response will then be used for the needed action of the request.

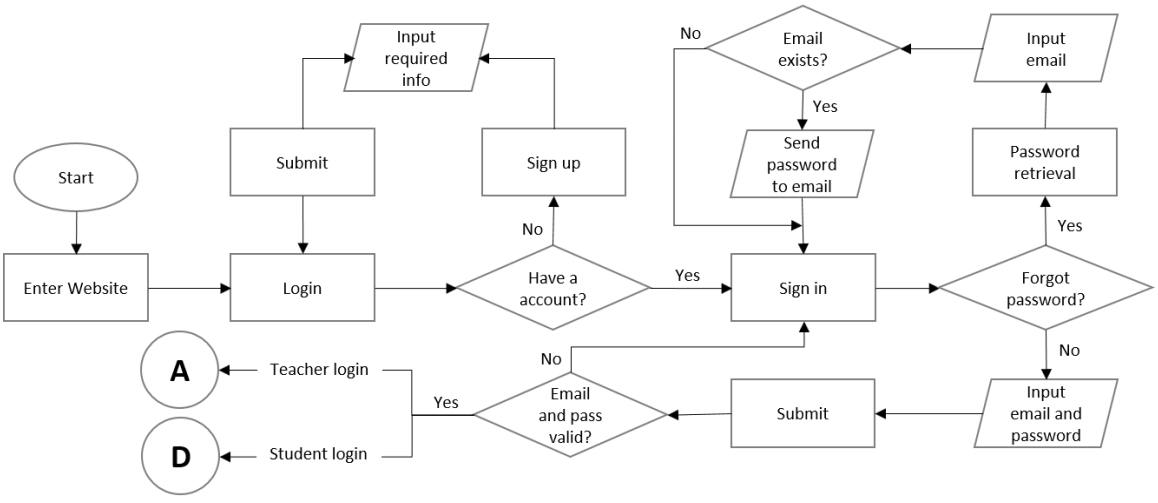

Fig. 9. Login, sign up, and password retrieval modules Control Flow Diagram (CFD) for student and teacher users of the system.

Control Flow Diagram (CFD) and System Mockups

Figure 9 shows an overview of how the user can enter the system by logging in if he or she already has an account or create his/her own account if otherwise by signing up, and how the user can retrieve his/her own account if he or she forgot the password.

Login page (*fig. 10*)

This is the log in page of the e-learning system. Users can log-in to the system using their e-mail address and password. There is also an option for a forgot password. Also, a sign-up button that will redirect to the sign-up page.

An e-mail address that is existing is recommended to be used, since the researchers will develop a password retriever and send the password to that existing email address. This way the forgotten passwords can be retrieved by the users.

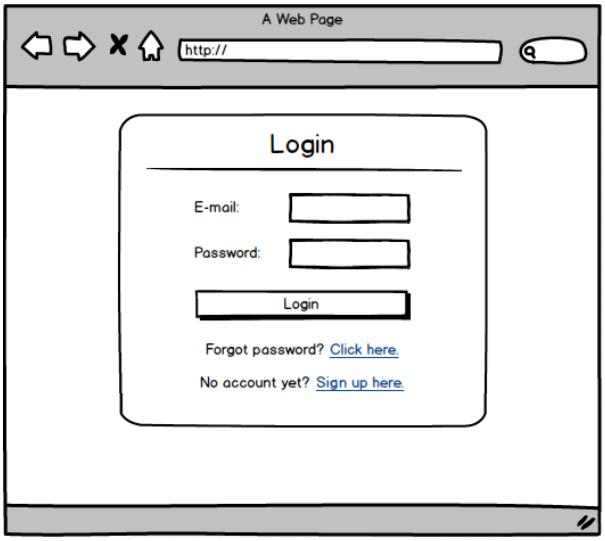

Fig. 10. Login page of the gamified system.

Fig. 11. Password retrieval page of the gamified system.

In this page, the user will only need to input their email and password on order to enter the website. If the input details are correct, the student user will be redirected to the student home page and the teacher user will be redirected to the teacher home page. Otherwise, the system will prompt a message stating that the input is incorrect.

Password retrieval page (*fig. 11*)

If a user forgets his/her password, he or she can recover it through this page. Only the user's email is required in the input section. If the input email exists, then the system will send a message to that email containing the password of the user. Otherwise, the system will prompt a warning message that the input email does not exists in the database.

Sign up page (*fig. 12*)

If a user doesn't have an account yet, he or she can create one through this page. To successfully create an account, the user needs to fill the necessary fields in the form for the submit button to be enabled. If the user inputs an email that already exists in the database, this will invalidate the form.

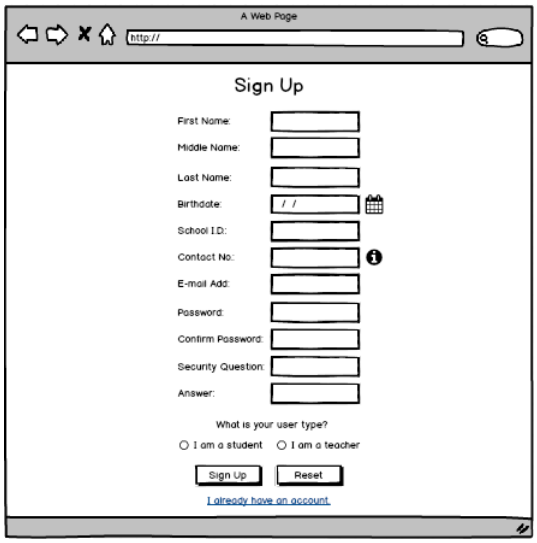

Fig. 12. Sign up page of the gamified system.

if the account that he or she wants to create is a teacher or a student account. A student's account will be created after submission, however a teacher's account will need to be approved by the admins through email to be created.

The diagram in figure 10 shows the first part of the student's module CFD. This is where the student can enroll in a specific course, view his profile, and check his news feed for any news from all off the courses he or she is enrolled to. End states are also not shown in the flowchart since the student can logout of the system anytime he or she wishes and

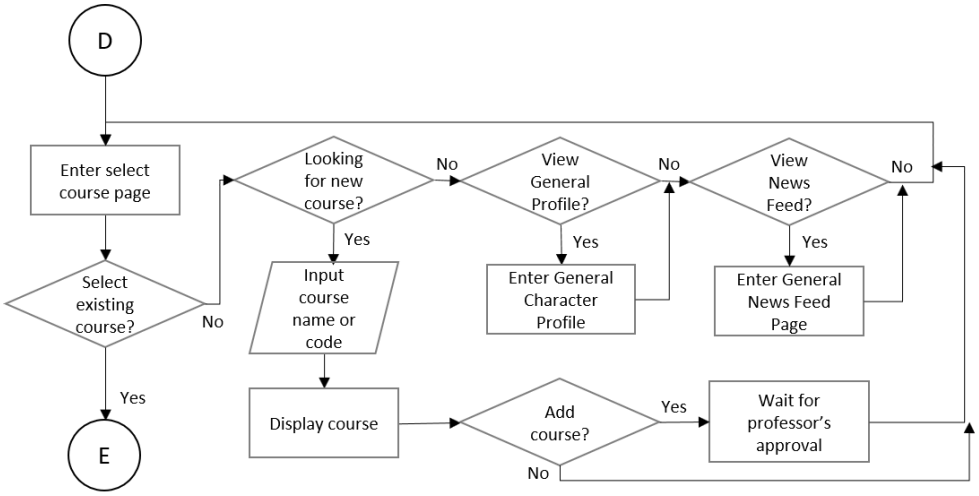

Fig. 13. Course management, profile, and news page modules CFD of the gamified system.

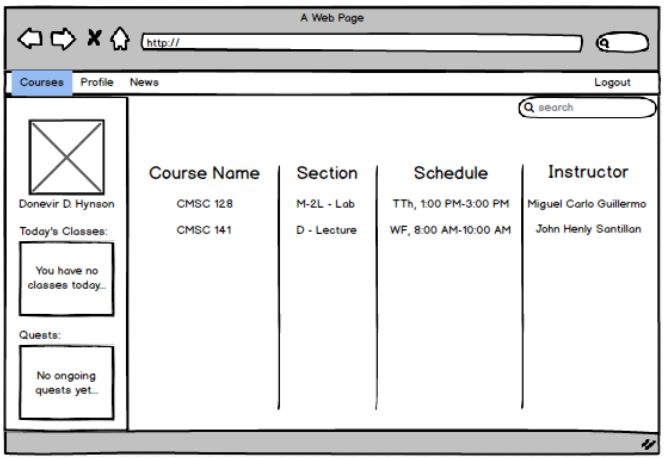

Fig. 14. Student - courses page of the gamified system.

in any pages he or she is in. Also, in all the pages that the student is going to visit for the first time, there is going to be a tutorial so that the student can understand what the pages do or the functions that it operates.

Student home page (*fig.14*)

Also known as the 'Courses' page. This is the page at which the student will first be redirected after signing in. If the student is not yet registered in any course, this is where he or she can look for a course and register in that certain course, otherwise the student can simply click on a course to visit that course's home page. There is a search bar available for the student's use. The student can either search for the course's title or the given course code. Upon registering, the student will wait for the teacher's approval before he or she can visit that course page. From this page, the student can also view the general newsfeed where all of the posts from the student's teachers in every course section is displayed. There is also a side tab in the student's interface. In this side tab resides a limited profile information and the list of ongoing quests that the student have not finished yet. From this page the student can visit the profile page and the specific course page.

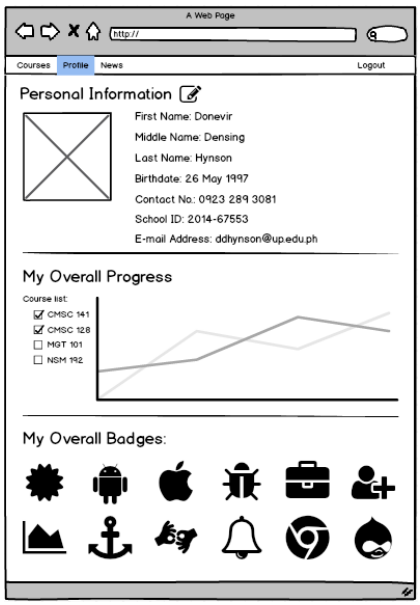

Fig. 15. Student – general profile page of the gamified system.

Student profile page (*fig. 15*)

In this page the student can view, or modify if he or she wishes, his or her student profile. The student can also view his or her overall progress in all of his classes through a graph or a chart that depicts the student's overall performance. Other than that, the student can also view the achievements and the badges that he or she has acquired in all of the courses he or she has registered in.

Student news page (*fig. 16*)

This page contains posts from the different teachers of enrolled courses. All posts are pooled in this page for the accessibility of the student to the news from his/her different courses. The student can comment in the posts but cannot create one. Clicking one of the posts will also redirect the student to the course page he or she clicked.

Going to the second part of the student's module CFD, figure 14 shows us an overview of this module. This is where the student can explore the specific course page he

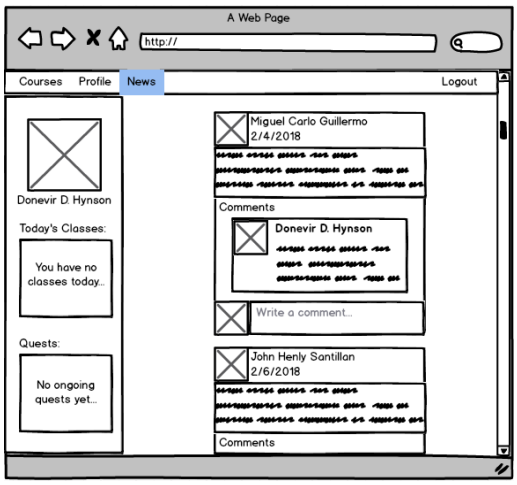

Fig. 16. Student – general news page.

or she is enrolled to. The student can view the course details, view his/her classmates' profiles, visit the news feed, check his/her own character and profile, and enter the quests page to either get a quest, submit, or quit.

Student character page (*fig. 18*)

The character page is where the student can view his or her virtual self. It shows here the health points (HP) and experience points (XP) of the student. Along with it is the inventory of the student where he or she stores the items that he or she has acquired from

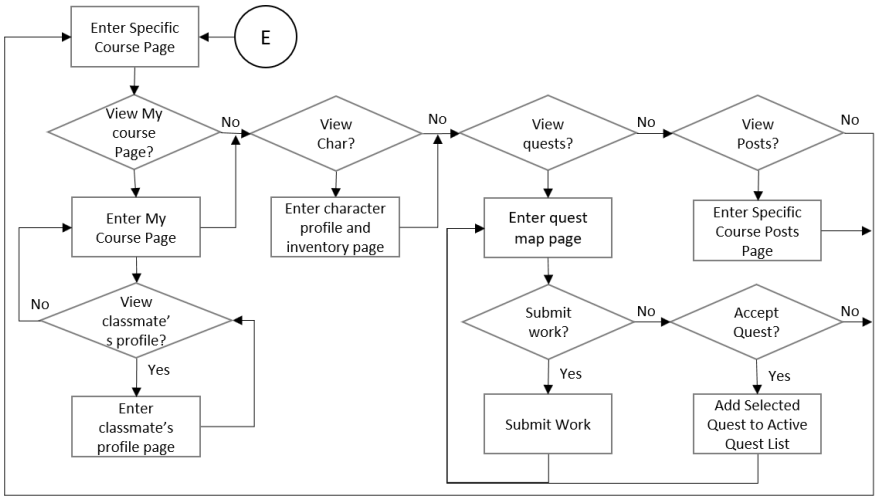

Fig. 17. Specific course details, character and student profile, quests, and news feed modules Control Flow Diagram (CFD) for student users of the gamified system.

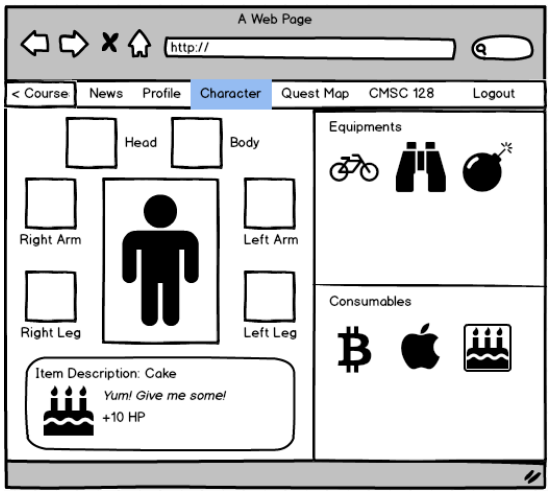

Fig. 18. Student – character page of the gamified system.

quest rewards. This is where the student can equip the wearable items and use the consumable items.

Student course news page (*fig. 19*)

This is where the newsfeed is found where their teacher in that course can post or broadcast messages. Students can comment in the posts but they cannot post or broadcast messages themselves. There is also a side tab where a simple profile is displayed and the ongoing quests that the student has not finished yet. From this page, the student can visit the character and profile page, the "my course" page, and the "quest map" page.

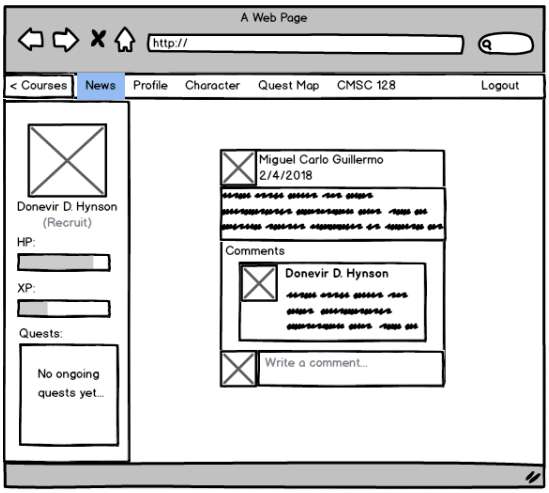

Fig. 19. Student – course news page of the gamified system.

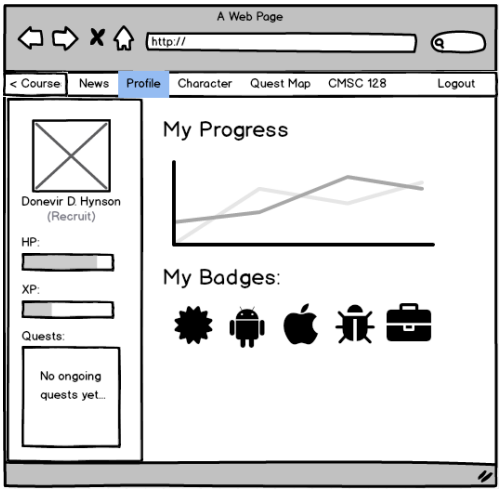

Fig. 20. Student – course profile page of the gamified system.

Student course profile page (*fig. 20*)

This course profile page is not entirely the same as the profile page elaborated earlier. Although both have similar contents like the basic profile information of the student, the progress and performance graphs, and the achievements and badges, they differ in the scope that they cover. The course profile page only covers the progress and performance graphs, achievements, and badges in that specific course section.

Student my course page (*fig. 21*)

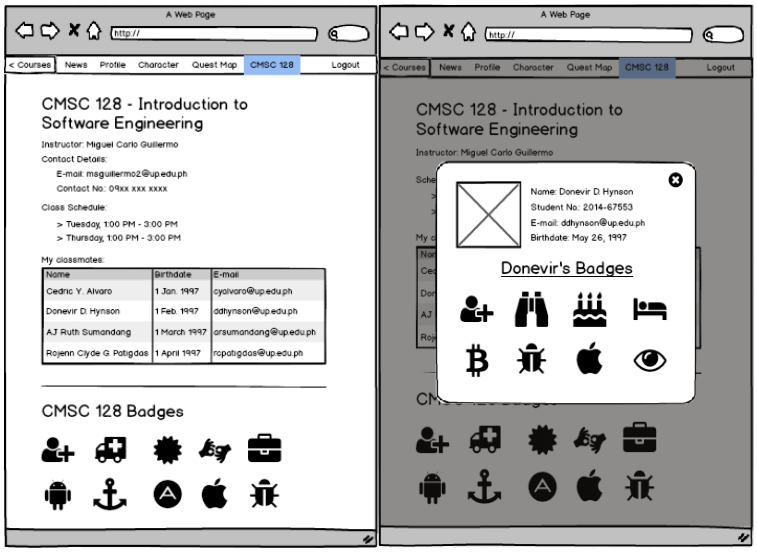

Fig. 21. Student – my-course page and viewing other's profiles.

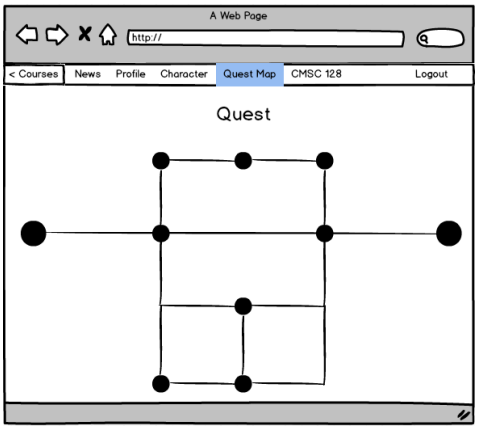

Fig. 22. Student – quest map page.

This page displays the course title, description, and the list of classmates of the student. The student can view each of his or her classmate's profile, but what the student can view is only the basic information of his or her classmate.

Student quest map page (*fig. 22 and fig. 23*)

This page is where the students receive quests and submit their outputs. The quest map, as mentioned before, is in the form of a grid. The students must do the quests under the main quest line and in order, however they can reroute in different side quests that also reach the next phase of the main quest. If the students are ready to submit their outputs, they can just visit the node of the quest they are currently doing and open the submission

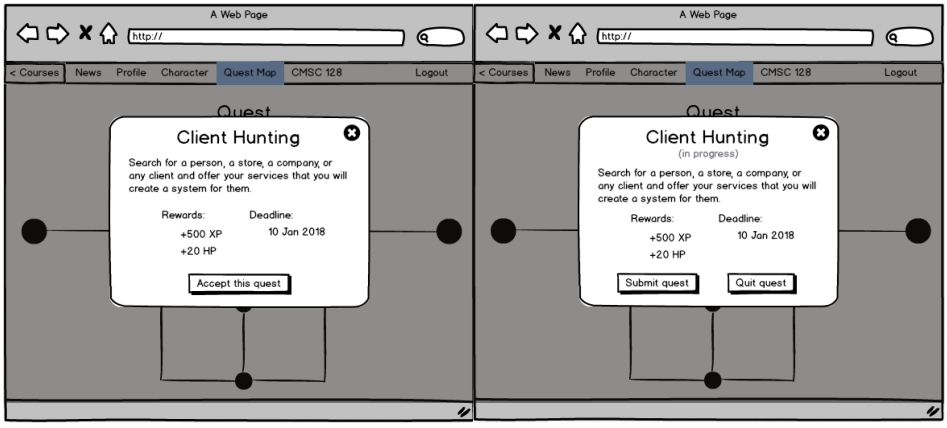

Fig. 23. Student – quest map page (submit, accept, and quit quest).

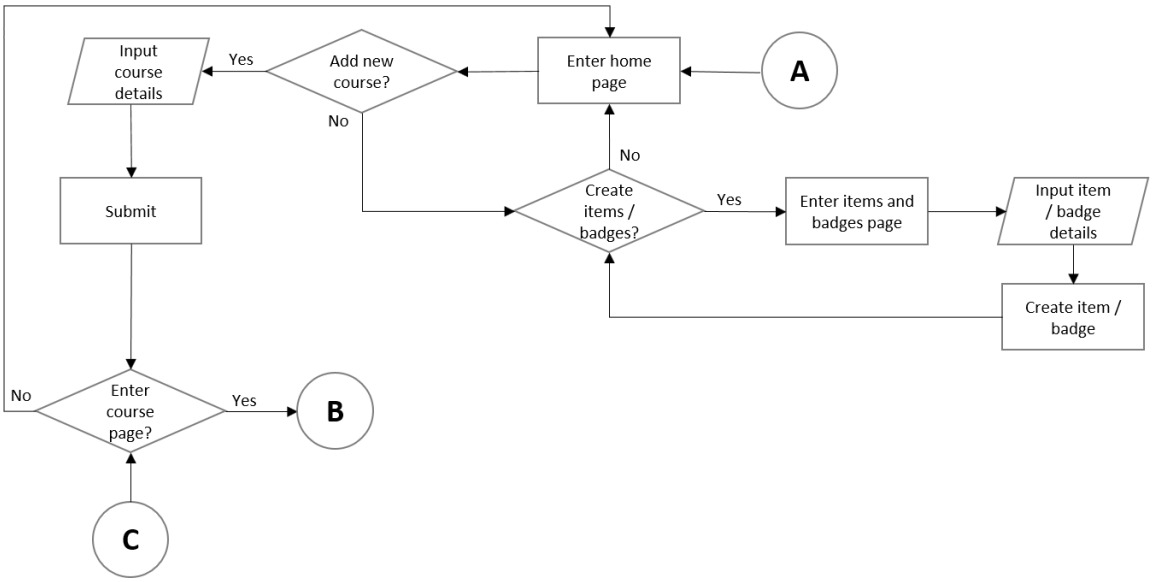

Fig. 24. Create new course and create, update, or delete inventory items modules Control Flow Diagram (CFD) for teacher users of the system.

bin to submit their work. On the other hand, students can also decided to quit an ongoing quest.

The diagram in figure 24 shows the first part of the teacher's module. This is where the teacher creates his/her course subjects, create, delete, or modify items in the inventory, and visit existing courses. End states are not shown in the flowchart since the professor can logout of the system anytime he or she wishes and in any page he or she is in.

Teacher courses page (*fig. 25*)

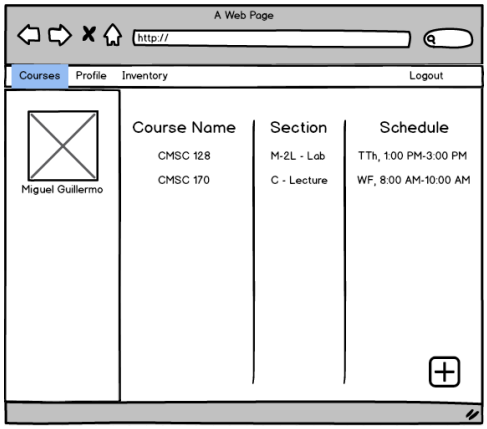

Fig. 25. Teacher – courses page of the gamified system.

After successfully signing, the teacher is redirected to the courses page. The courses page is where the teacher manages the specific course he or she is teaching. The teacher can add courses that he or she is teaching, add more sections and their corresponding teachers if there exists more than one section, and modify his or her own profile. From the this page, the teacher can either go to whichever course he or she wishes to visit by clicking on a course subject, or go to the items and badges page.

Teacher inventory page (*fig. 26*)

In this page, the teacher manages all of the items and badges that can be rewarded to the students. There are a few pre-existing badges that the teacher can use but there are no pre-existing items. The teacher can add more badges and items in the system. In adding badges, the teacher should determine the name, description, visuals, and purpose of the badge. The items on the other hand are classified into two: “consumables” and “wearables”. Consumables are those items that the students can use only once. Upon using, the effects of the consumable will be applied to the student then the item will be discarded in their respective inventories. “Wearables” are those items that the students can equip, or in other

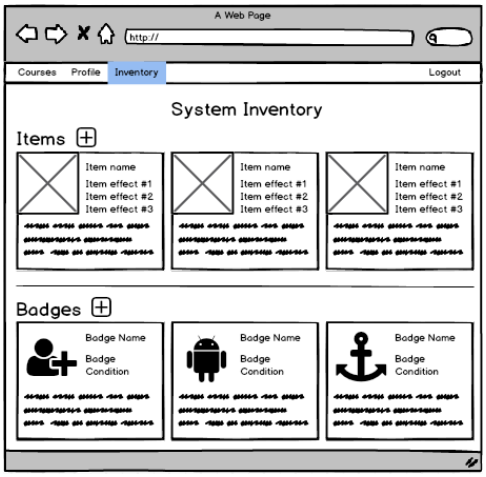

Fig. 26. Teacher – inventory page of the gamified system.

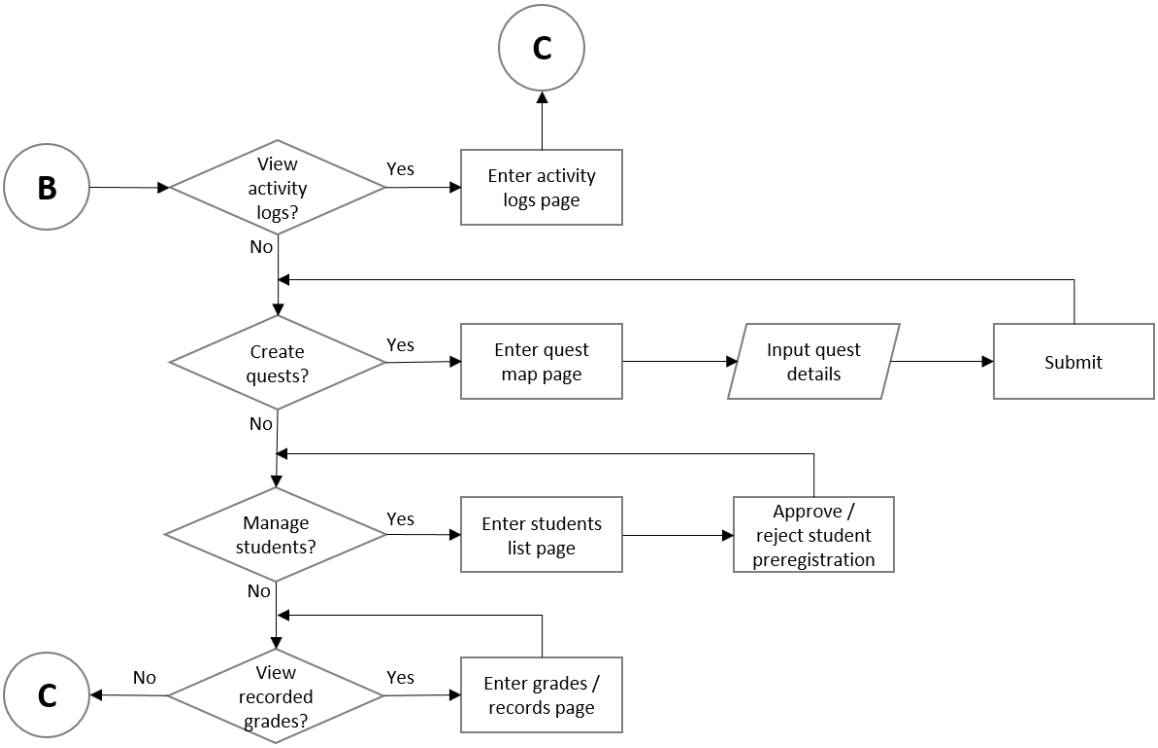

Fig. 27. Activity logs, quests, student management, and student grades module Control Flow Diagram (CFD) for teacher users of the system.

words wear. The effects of the item will be applied to the student equipping. The effects can be removed upon removing the item or losing the item if the durability reaches zero.

Going to the second part of the teacher's module CFD, figure 27 shows us an overview of this module. This is where the teacher can view the activity logs, create, update, or delete quests, manage his/her students, and view, print, or modify the students' grades.

Activity log page (*fig. 28*)

The system has this feature which records the time, date, event, and the students who caused the event in a simple list of texts. Every action that the students make, such as submitting a requirement or the event of logging and out, will be recorded in this log. To

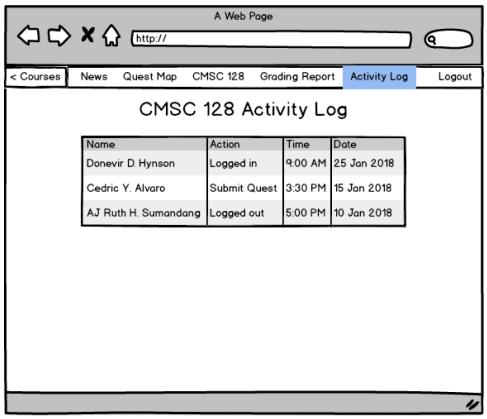

Fig. 28. Teacher – activity log of the gamified system.

the teacher, it is for security purposes where he can double check and verify certain events if it ever comes to need.

Teacher news page (*fig. 29*)

The teacher's newsfeed of the class is located here. Note that the teacher has different newsfeeds if he or she is teaching different courses. In the teacher's newsfeed, he or she can broadcast news updates, or posts, to the entire students enrolled in that class.

Teacher grading page (*fig.* 30)

This page contains the teacher's course grading scheme. In a table form, this is where all of the students' grades, referred to as experience points, are recorded per quest

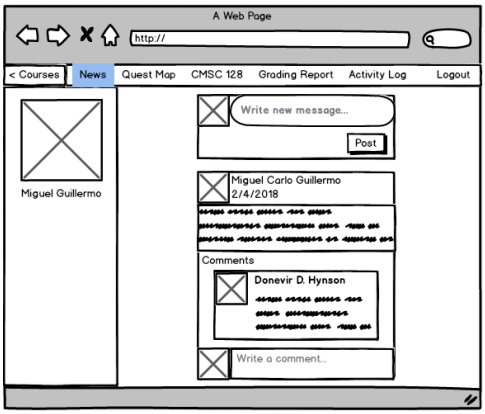

Fig. 29. Teacher – news page of the gamified system.

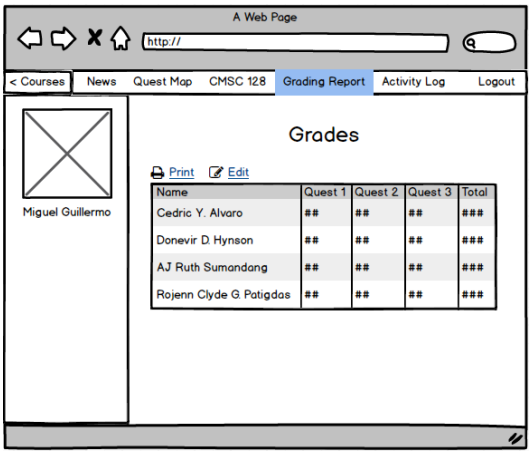

Fig. 30. Teacher – grades page of the gamified system.

completed. The grades are automatically calculated. What the teacher only needs to do is to set the experience points rewards in the quests, then the system will calculate the grade of the students based on the overall experience points. The teacher can also alter the recorded grades if preferred. Exporting the table into a spreadsheet or excel format is also supported.

Teacher quest map page (*fig. 31*)

All of the class activities, called quests, are created in this page. The quest map is in the form of a grid. Nodes at the intersecting lines of the grid are where the quests can be

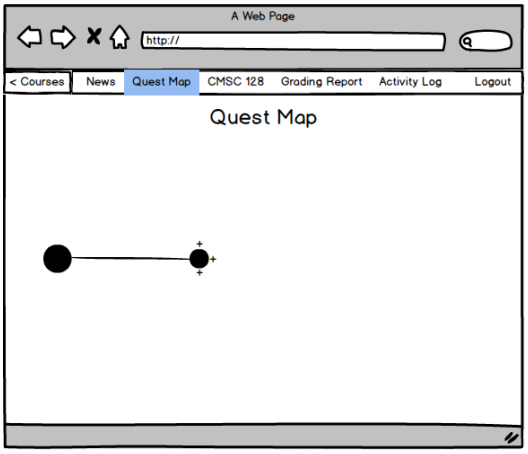

Fig. 31. Teacher – quest map page of the gamified system.

created. The quests can also be locked if prerequisite quests are not completed. The main quests are mandatory to complete while the side quests are optional, though students may find other ways to complete and follow the main quest through completing series of side quests that connects back to the main quest. When creating a quest, the teacher supplies the quest description, instructions, rewards, deadline, type, and consequences if preferred. The type of quest refers to the type of submission the students are going to make. Submission types are either in text, picture, or code format.

Teacher my-course page (*fig.* 32)

This is page is where the teacher can find the list of students who are registered in his or her class. Other than that, this is also where the teacher can either approve or reject the students who are seeking approval for the registration of the teacher's class. Prior to this, however, the teacher should know or already have the list of students who are going to register in his or her class. The system only serves as a platform for the gamified class and not a registration system.

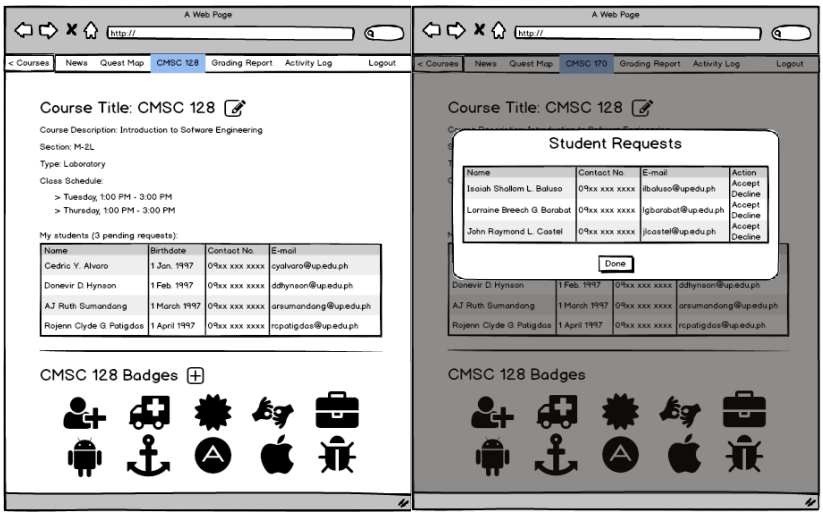

Fig. 32. Teacher – my-course page (left) and request approval (right).

Data Flow Diagram (DFD)

Shown in figure 33 is the Data Flow Diagram (DFD) Level 0 of the gamified system. This is the general flow of data from the users, to the system, and to the database.

Process 1.0: The Gamified System

1. Processing detail: Manages the requests of the different teachers and student users, allowing interaction not just with the system but with the other users as well.
2. Input: Different users, teachers and students, requests or the data being communicated by the users to the system. Requests such as creating a new account, logging in, different CRUD operations, and etc.
3. Algorithm applied: There are different processes in the system depending on the type of user who created the request. If the user is a teacher, then the request will be handled specifically in the teacher processes. Same goes if the user is a student then to the student processes.
4. Output: The output depends on what request has been made. If the request is signing up, then the system will save the details of the user in the database, creating a new account of the user.

Shown in figure 34 is the Data Flow Diagram (DFD) Level 1 – User Login Module from process 1.0. This describes the data flow when the user tries to log in to the system.

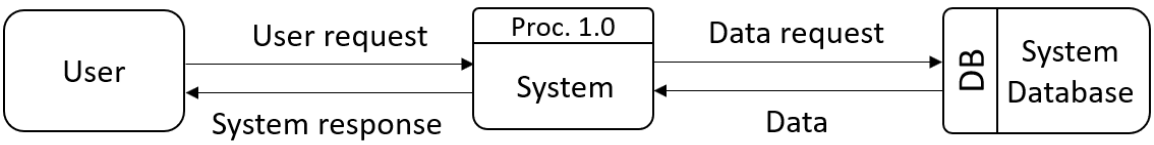

Fig. 33. The gamified system Data Flow Diagram (DFD) Level 0.

Process 1.1: Checking Login Credentials

1. Processing detail: After the user submits the email and password inputs, these data will then be compared to the data in the database if the input data exists or not.
2. Input: The user email and password.
3. Algorithm applied: The email and password input data will be used to search the database. If there's a match of both the email and password, then the user is valid and will be able to enter the system. Otherwise, the system will send a signal to prompt an error message.
4. Output: If the user login credentials are correct, the user will be able to enter the gamified system. If the user is a student, then he or she will enter the student's module. If the user is a teacher, then he or she will enter the teacher's module. Otherwise, if the login credentials are incorrect, the system will prompt a message to the user stating incorrect email and password inputs.

Process 2.0: The Teacher Module

1. Processing detail: Manages the requests of all teachers making operations to the items, quests, badges, and courses. It also allows teachers to authorize which students should be able to join a course.
2. Input: Data regarding the courses, sections, posts, grades, items, quests, and badges.
3. Algorithm applied: CRUD operations in the database, flags, and conditions.
4. Output: The output depends on the CRUD operations the teacher did. Either deleting some posts or updating them.

Process 3.0: The Student Module

1. Processing Detail: Manages the requests of all students interacting to the teacher's design of the course.
2. Input: There are different input data for the student module. Included are quests taken, and enrolled courses.
3. Algorithm applied: Students are allowed to choose their course and do the given quests.
4. Output: Output depends on the input of the students. They can search courses or make comments on their professor's posts.

Shown in figure 35 is the Data Flow Diagram (DFD) Level 1 – User Sign-up Module from process 1.0. This describes the data flow when the user signs up to create a new account in the system.

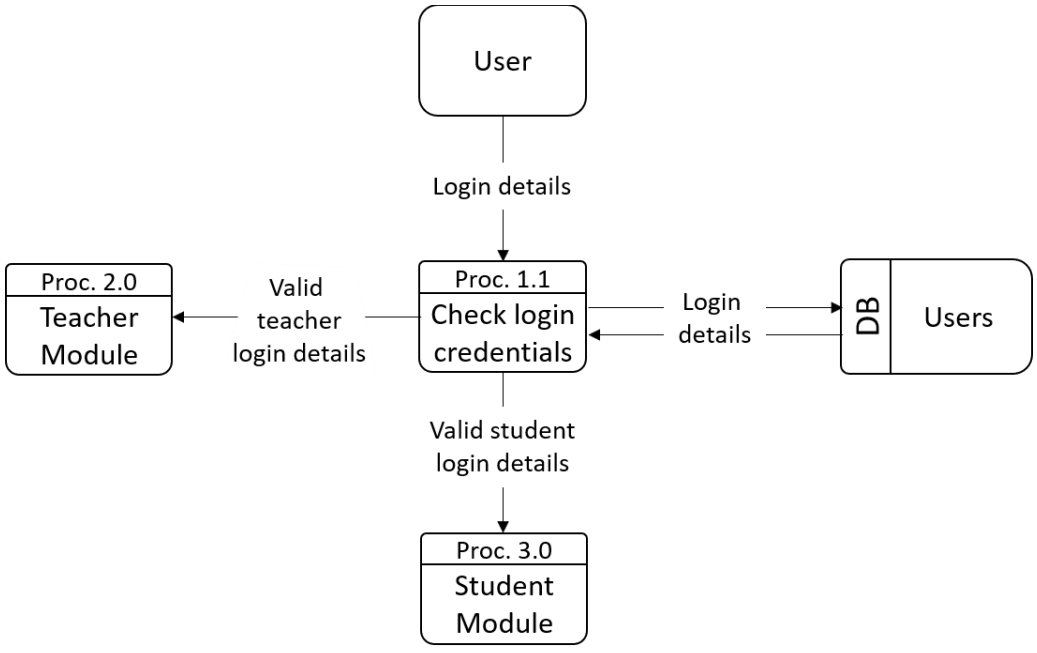

Fig. 34. The gamified system Data Flow Diagram (DFD) Level 1 of the login module.

Process 1.2: Checking Duplicate Email

1. Processing detail: After the user submits his or her sign up credentials, the email will then be extracted to be used to check if that certain user already exists in the database or not.
2. Input: The input ranges from the user's first, middle, and last name, contact information, and etc., but the data that will be needed in this process is just the user's email.
3. Algorithm applied: The email provided by the user will be used to search for a match in the database. If a match is found, then that sign up request will be invalid since that user, through the presence of his or her email in the database, already exists. Otherwise, the sign up request will be approved and the system will save the credentials in the database.
4. Output: If the user doesn't exists yet in the database, then a new account will be created. Otherwise, the system will prompt an error message stating that the email the user used already exists in the database.

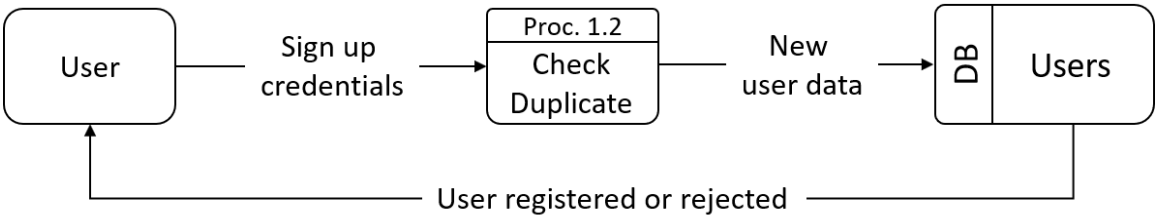

Fig. 35. The gamified system Data Flow Diagram (DFD) Level 1 of the sign-up module.

Shown in figure 36 is the Data Flow Diagram (DFD) Level 1 – User Password Retrieval Module from process 1.0. This describes the data flow when the user requests the system to retrieve the password he or she has forgotten.

Process 1.3: Checking Email Validity

1. Processing detail: The email provided by the user will be used by the system to compare to the database if that email exists or not.
2. Input: User email.
3. Algorithm applied: The system checks the database if the input email exists or not. If the email exists, then it is passed on to the password retrieval process. Otherwise, the system will prompt an error message stating that the email doesn't exist.
4. Output: If the input email exists, then the system will use that email to acquire its corresponding password in the next process.

Process 1.4: Retrieving Password from Database

1. Processing detail: The password retrieved from the database will be sent as a message addressed to the input email.
2. Input: User email.
3. Algorithm applied: The email will be used to find a match in the database. If found, then its corresponding password will be extracted and will be sent to the email of the requesting user.

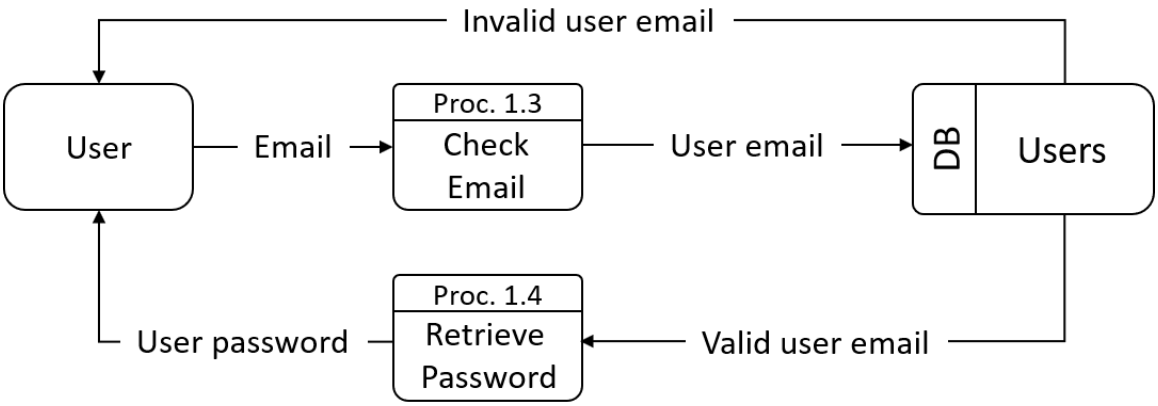

Fig. 36. The gamified system Data Flow Diagram (DFD) Level 1 of the password retrieval module.

4. Output: The user will be able to receive an email containing his or her password of the system.

Shown in figure 37 is the Data Flow Diagram (DFD) Level 2 – Teacher's Module from process 2.0. This describes the data flow when the teacher interacts with the system.

Process 2.1: (CRUD) Create, Read, Update, and Delete operations for Items, Quests, Badges, Courses

1. Processing detail: Teacher will send requests to create, read, update, or delete some items, quests, badges, or courses.
2. Input:
    a. Create - Inputting the necessary object's attributes from the teacher.
    b. Read - Input keyword from the user. This will serve as the filter variable to be searched in the database.
    c. Update - Input new attributes for the object to be edited.
    d. Delete - The selected object.
3. Algorithm applied: Mongo DB operations to do the CRUD operations.

4. Output:
    a. Creating a new entry to the database and reflecting the results to the system.
    b. Reading data from the database will provide the information that is being used shown in the user interface.
    c. Updating data would reflect the changes in the system too.
    d. Deleting would remove the data from the database.

Process 2.2: Quest Handling Module

1. Processing Detail: The quest submitted by the student may be accepted or declined by the teachers. Student quest data are from the sections collection in the database. Submitted quests are also handled by this process and is stored.
2. Input: Students data regarding the quest from the sections collection.
3. Algorithm applied: By making an authority whether a submitted quest should be accepted or not is a way for double checking whether the data from the students is acceptable. Storage is applied in submitted quests and should be accessed by teacher of the course.
4. Output: Submitted data from students.

Process 2.4: Comment/Post Module

1. Processing Detail: Allows the teacher to perform CRUD operations on comment posts. The comment and post data can be retrieved from or sent to the posts collection in the database.
2. Input:

a. Create - The content of the teacher's comment/post and the optional attachments (photos, files, etc.). If comment is created, the system also inputs the id of the commented post.
b. Read - The system inputs the current user's id, allowing the teachers to read all posts that are visible to them.
c. Update - The edited content of the teacher's comment/post. If comment is created, the system also inputs the id of the commented post.
d. Delete - The system inputs the id of the comment/post to be deleted. If comment is created, the system also inputs the id of the commented post.

3. Algorithm applied: Mongo DB operations to do the CRUD operations.
4. Output:
    a. Create - A new entry in the database and a new comment/posts in the system.
    b. Read - Comment post of the retrieved entry from database with information such as the poster, content, date of creation, comments, etc.
    c. Update - Updated comment post both in the database and the system.
    d. Delete - Deleted comment post no longer showing in the system and its entry is removed from the database.

Process 2.5: Grades Module

1. Processing Detail: The quest submitted by the students are reflected in a grading sheet where the teacher could also update this grading sheet for certain purposes.
2. Input: Grade data from the database.

3. Algorithm applied: There is a point system given by the teacher in each quest for the automated grading sheet. This way he/she could update the grades through this module.
4. Output: Updated grades of the students.

Process Module 2.6: Teacher Profile

1. Processing Detail: The teacher is able to view or edit his information that is reflected in the system such as name, password, security question, etc. This information is in the users collection from the database.
2. Input:
    a. Create - The content of the information to be added and which attribute is it to be added (name, date of birth, etc.).
    b. Read - The system inputs the id of the user whose information is to be viewed.
    c. Update - The edited information made by the teacher and which attribute the change was made.
3. Algorithm applied: Mongo DB operations to do the CRUD operations. The changes that happened in the database are reflected by the system.
4. Output:
    a. Create - A new entry in the database which is reflected in the system after addition.
    b. Read - The information such as name, email, birthdate, etc. retrieved in the database is reflected in the system depending on the inputted id by the system.

c. Update - An updated entry in the database with the changes reflected in the system as well.

Shown in figure 38 is the Data Flow Diagram (DFD) Level 2 – Student's Module from process 3.0. This describes the data flow when the student interacts with the system.

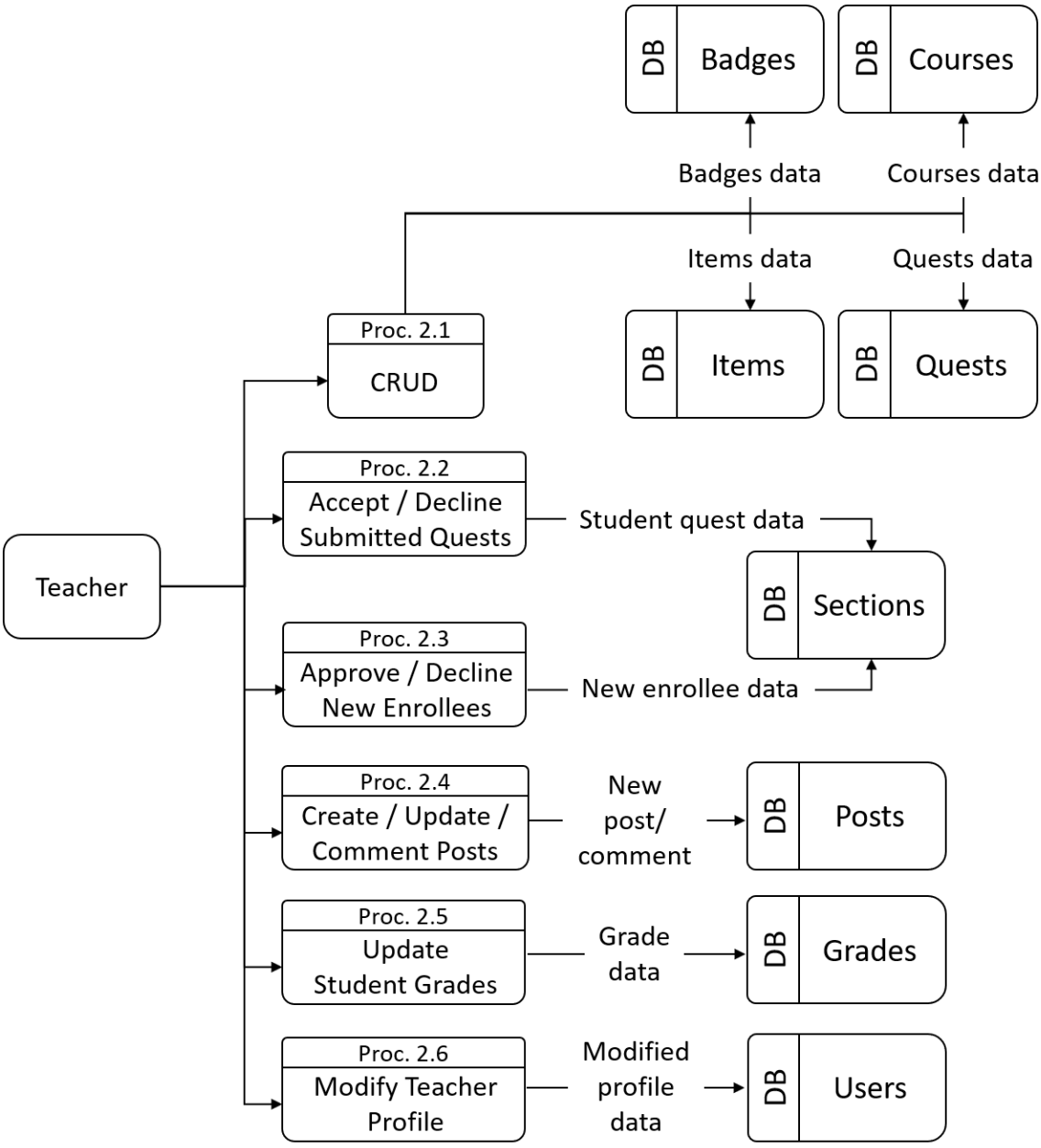

Fig. 37. The gamified system Data Flow Diagram (DFD) Level 2 of the teacher's module.

Process 3.1: Course Enrollment Module

1. Processing Detail: Based on the course list displayed, the user may opt to enroll in a chosen course and the system sends its request to the courses collection in the database.
2. Input: The data of the enrolling student.
3. Algorithm applied: The system sends the request of the enrolling student which puts the student in the section's list of students with the status of 'requesting' until the teacher approves of the request.
4. Output: The updated section's list of student and student's list of enrolled sections with the status 'requesting'.

Process 3.2: Wearable Item Modules

1. Processing Detail: Manages the student's wearable item. It also applies the status effects of the item if available. Wearing or removing the item updates the items collection and the sections collection in the database.
2. Input: The wearable item chosen by the user to be used or removed.
3. Algorithm applied:
    a. Wear - The chosen item is transferred by removing the item from the student's inventory and added to the worn item with the consideration of the item's type (head, left arm, right leg, etc.).
    b. Remove - Reverse of wearing process; the item is removed from the worn item and added back to the student's inventory.

4. Output: The updated student inventory and worn item both in the database and the system. If worn or removed item is with status effects, the effect is added if worn and stopped if removed.

Process 3.3: Consumable Item Module

1. Processing Detail: Manages the usage of consumables. Students use consumables to gain advantage or cope up. It serves as a booster or some bonus assignments.
2. Input: Student id is reference as to which student will acquire certain types of consumables. Inputs may vary as to what and how many quests the students will take.
3. Algorithm applied:
    a. Consume - As the student uses a consumable, the quantity of his/her consumable item will decrease. Consumables are items that could be stacked.
    b. Acquire - Consumables stack so a number right next to the item will be the identifier of the quantity of your item.
4. Output: Updates the record of consumable items of students whenever he/she acquires or consumes. The consumables effect should also take effect after using it.

Process 3.4: Student Quest Module

1. Processing Detail: Manages the student's quest. It handles the student's quest operation such as accepting, submitting or abandoning a quest.
2. Input:

a. Accept - The system inputs the id of quest accepted by the student.
b. Abandon - The system inputs the id of quest abandoned by the student.
c. Submit - The data submitted by the student placed in the submission bin.

3. Algorithm applied:
   a. Accept/Abandon - After system sends request of accepting or abandoning a quest to the database, the quest is added from the list of student's ongoing quest if accepted and removed if abandoned.
   b. Submit - The information submitted by the student will be sent to the storage.
4. Output: The student's updated list of the ongoing quests both in the database and in the system.
   a. Accept - The quest will be added to the quest list.
   b. Abandon - The quest will be removed to the quest list.
   c. Submit - The quest will be removed to the quest list with system informing user of the successful/failed submission.

Process 3.5: Student Post Module

1. Processing Details: Manages the student's activity regarding comments/posts. It supports CRUD operations on comments if the student is the one who made the post. The posts can be found in the posts collection in the database.
2. Input:
   a. Create - Content of the student's comment.
   b. Read - System inputs the current user.
   c. Update - Edited content of the student's comment.

d. Delete - System inputs the id of the post and the comment.

3. Algorithm applied:
    a. Create - An entry will be created in the database after the system sends the student's input. The post where the comment was made will also be updated.
    b. Read - The database will send the comment visible to the current user.
    c. Update - The database will update the information of the existing entry based on the received edited content and which post and comment is to be updated.
    d. Delete - The comment's entry will be deleted in the database which will reflect in the system. The list of comments of the post where the comment was deleted will be updated as well.
4. Output
    a. Create - A new entry and a post's updated list of comments in the database which will be displayed in the system.
    b. Read - The comment/post visible to the current user.
    c. Update - Updated information of the comment both in the system and database.
    d. Delete - A deleted entry in the database with the comment removed from the post both in the system and the database.

Process 3.6: Student Profile Module

1. Processing Detail: The student is able to view or edit his information that is reflected in the system such as name, password, security question, etc. This information is in the users collection from the database.
2. Input:
    a. Create - The content of the information to be added and which attribute is it to be added (name, date of birth, etc.).
    b. Read - The system inputs the id of the user whose information is to be viewed.
    c. Update - The edited information made by the teacher and which attribute the change was made.
3. Algorithm applied: Mongo DB operations to do the CRUD operations. The changes that happened in the database are reflected by the system.
4. Output:
    a. Create - A new entry in the database which is reflected in the system after addition.
    b. Read - The information retrieved in the database is reflected in the system depending on the inputted id by the system.
    c. Update - An updated entry in the database with the changes reflected in the system as well.

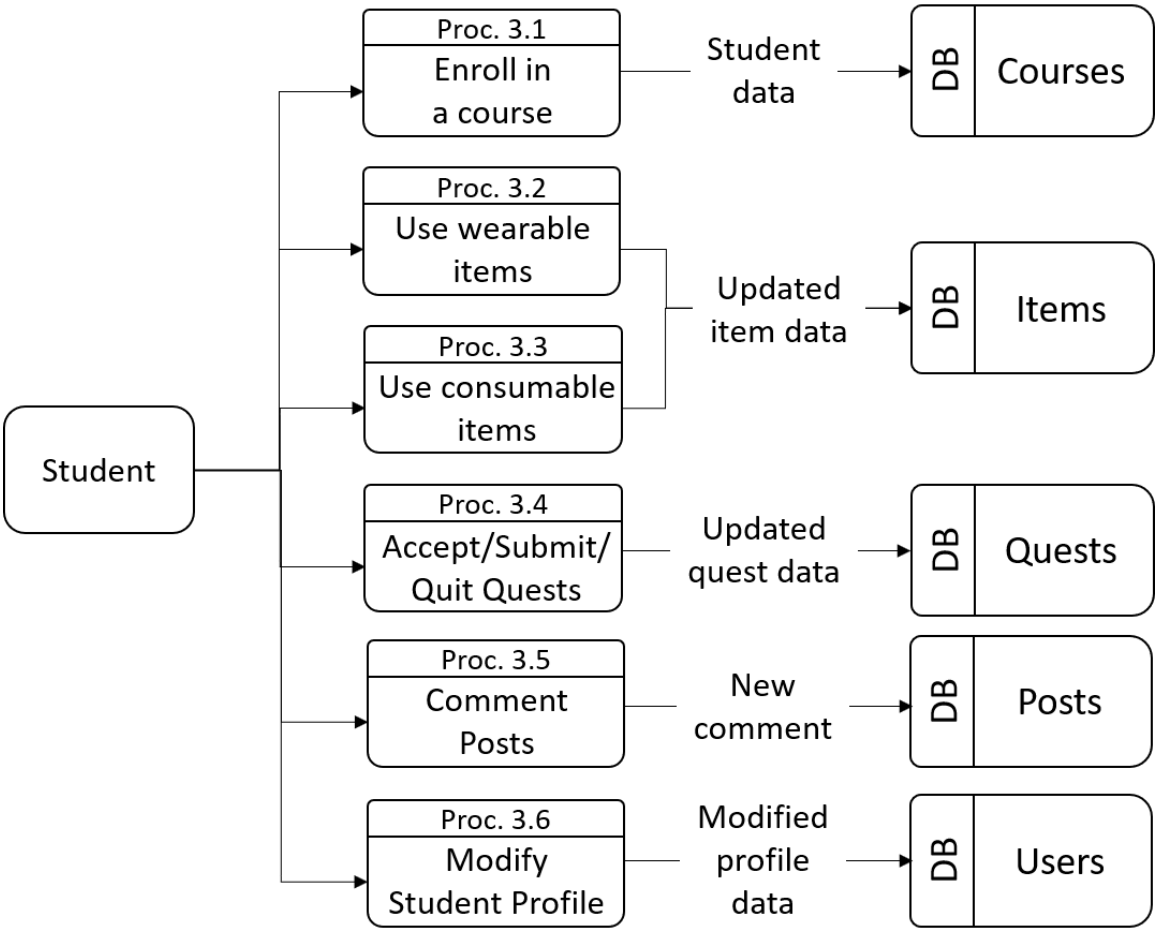

Fig. 38. The gamified system Data Flow Diagram (DFD) Level 2 of the student's module.

Function Decomposition Diagram (FDD)

Figure 39 shows the function decomposition diagram (FDD) of the gamified system. The system functions are divided by the two major modules: the teacher and the student modules. In the login module however, a separate module from the teacher and student, its functions are shared by both the teacher and student users.

Functions that are commonly used by both the student and teacher users are the login, sign up, password retrieval, and logout functions. One function that is also common for both is the comment-to-post function as both users can comment in a certain post.

Teacher-specific functions are: create and modify course, modify profile, add, delete, and modify inventory items for both wearables, consumables, and badges, write posts, approve and decline student requests to enter course, add, delete, and modify quests, accept and decline submitted quests, view the activity logs and other students' profiles, and view, print, or modify the students' grades. The teacher has full detail view of students' profile.

Student-specific functions are: enrolling in a course, modify profile, equip and unequip wearable items, use consumable items, accept, submit, and quit quests, and view classmates' profile. The student has only a partial detail view of classmates' profile.

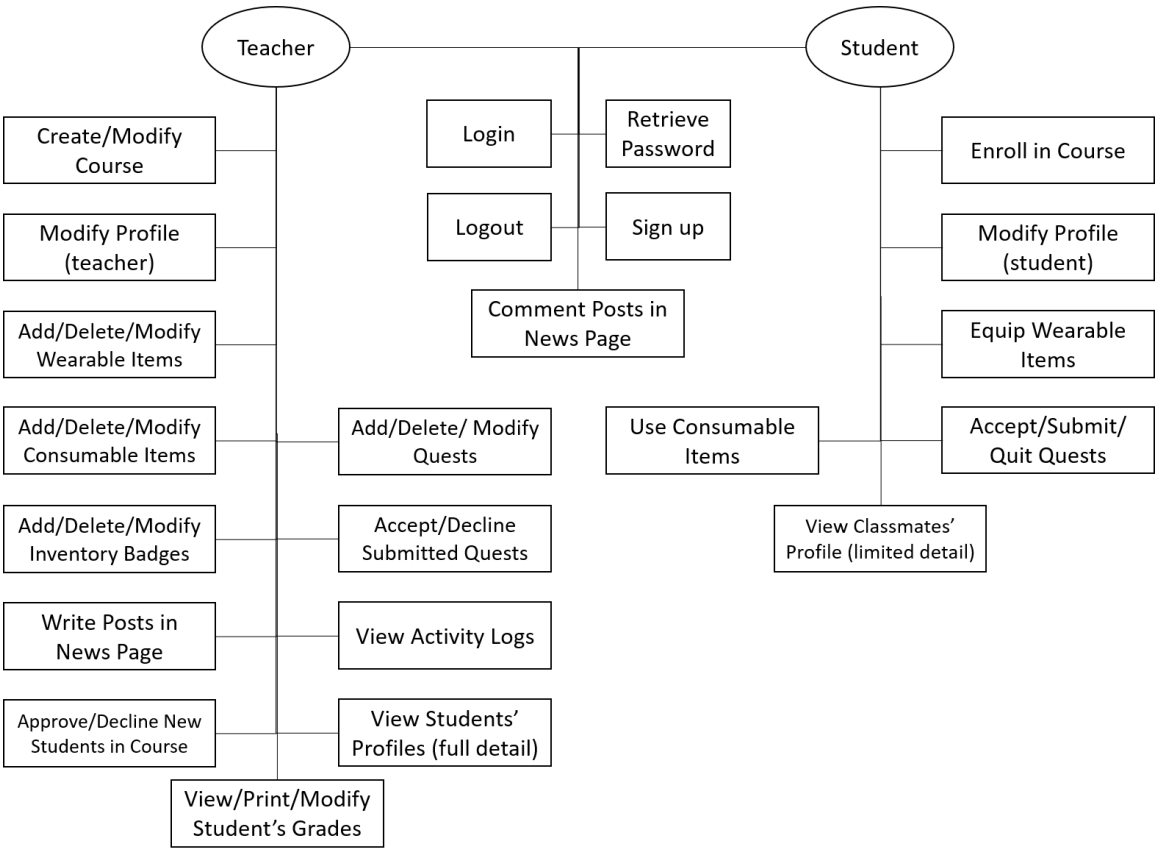

Fig. 39. Function Decomposition Diagram (FDD) of the gamified system.

Entity relationship diagram (ERD)

This is the diagram that shows the connection of each user to the database. It shows the types and attributes and the data that are needed to connect and get data from another entity. In Figure 40 shows the ERD of the system.

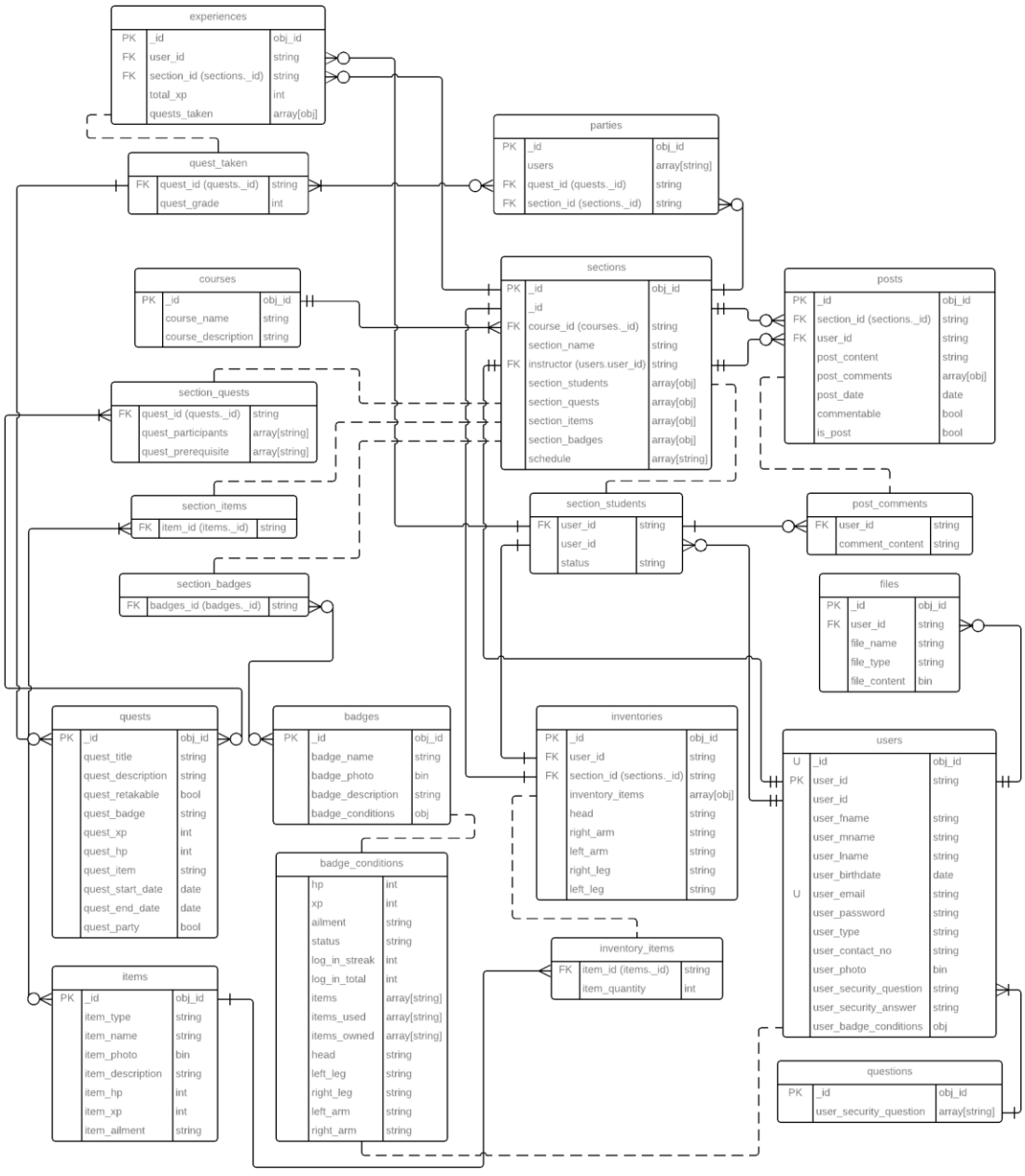

Fig. 40. Entity Relationship Diagram of the gamified system

The cardinality describes the quantity of each entity needed by the connected entity. It is shown that there are one to one relationships, one to many, zero or more, or one and only one. This way we will now the access of each entity to other entities.

Function Decomposition Diagram (FDD)

Figure 41 shows the function decomposition diagram (FDD) of the gamified system. The system functions are divided by the two major modules: the teacher and the student modules. In the login module however, a separate module from the teacher and student, its functions are shared by both the teacher and student users.

Functions that are commonly used by both the student and teacher users are the login, sign up, password retrieval, and logout functions. One function that is also common for both is the comment-to-post function as both users can comment in a certain post.

Teacher-specific functions are: create and modify course, modify profile, add, delete, and modify inventory items for both wearables, consumables, and badges, write posts, approve and decline student requests to enter course, add, delete, and modify quests, accept and decline submitted quests, view the activity logs and other students' profiles, and view, print, or modify the students' grades. The teacher has full detail view of students' profile.

Student-specific functions are: enrolling in a course, modify profile, equip and un-equip wearable items, use consumable items, accept, submit, and quit quests, and view classmates' profile. The student has only a partial detail view of classmates' profile.

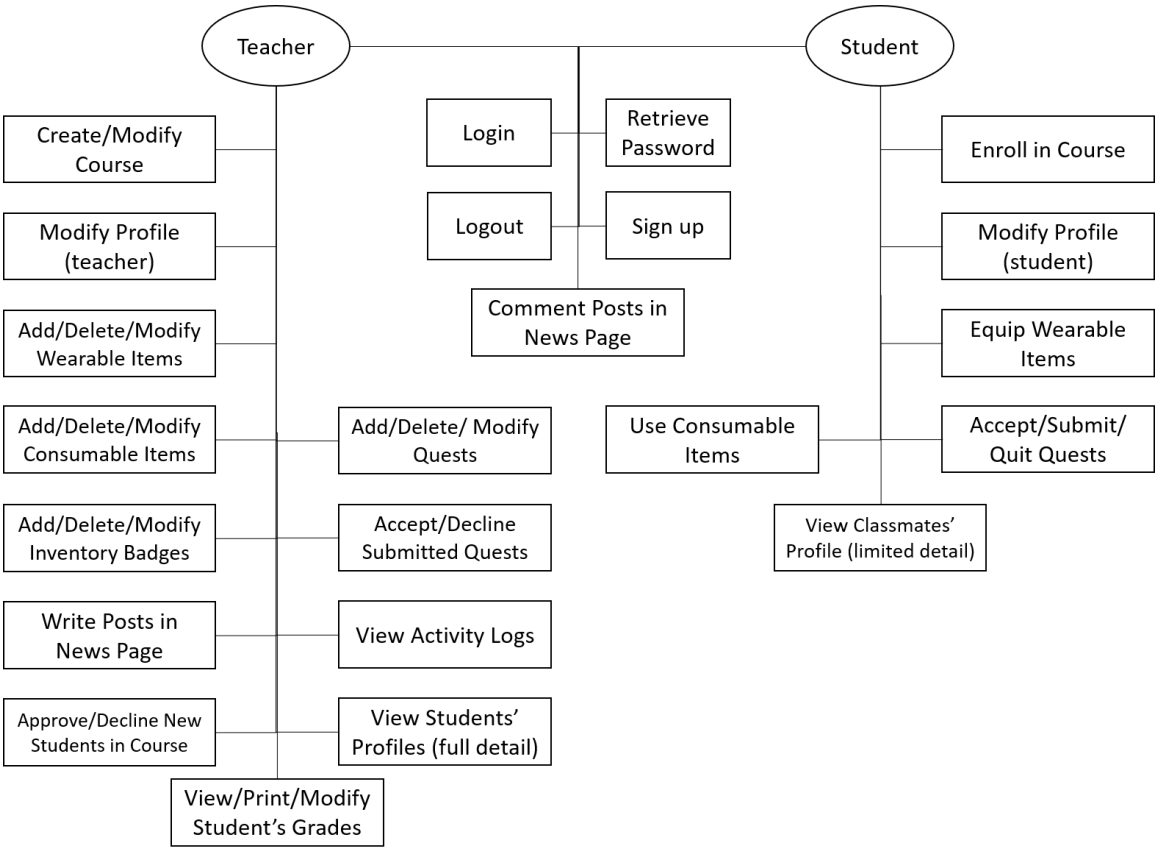

Fig. 41. Function Decomposition Diagram (FDD) of the gamified system.

Proposed Badge Mechanic

A badge mechanic that will have an outside scope to encourage users to be more active in the said e-learning system. Daily badges will be shown and held temporary and will be counted till the week is finished. A weekly badge will then be rewarded and will just be unlocked if consecutively logged in to the e-learning system for the same number of meeting days or more. A limited monthly badge will also be rewarded that may have additional rewards to foster a continuous engagement to the e-learning system.

Daily badges. A temporary badge will be given every day, specifically the meeting day of the course. A quantifier will be displayed along with the daily badge. When the

quantifier reaches a certain amount, the daily badge will reset the quantifier for the next week's badge. In Fig. 42 the sample daily badge is shown.

Weekly badges. A permanent badge that describing the week's quests and other events or course topics has resemblance to the signifier and description of the weekly badge. It will be earned and will be shown in the user's profile. It may also describe the quest of that week. The badge is referring to road to a Google developer shown in Figure 43.

The weekly badge can come in different pictures. This one is a proposed sample. This badge can be earned if a student has a daily log-in streak and fulfilled some quests.

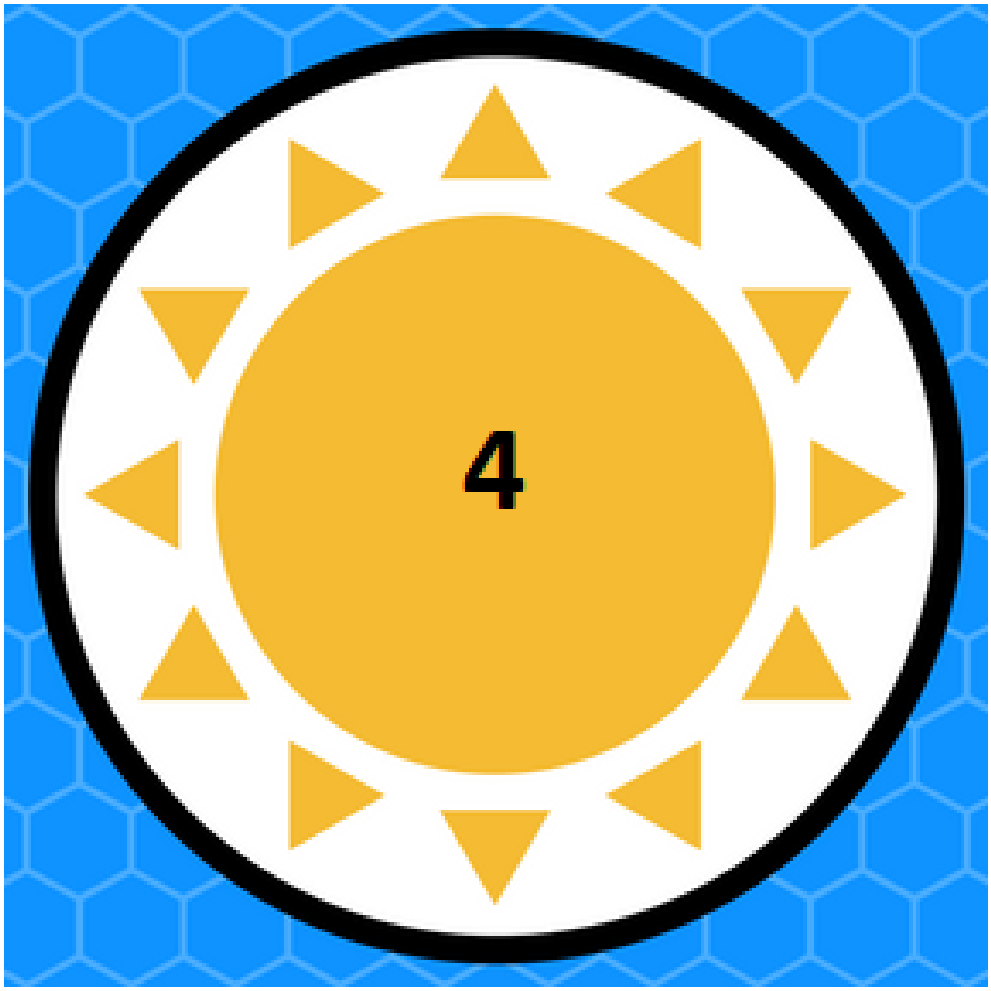

Fig. 42. Example of the daily badge

Fig. 43. Example of a weekly badge

Monthly badges. Monthly badges are considered higher degree badges as is the hardest to earn from the three kind of badges. Monthly badge may be given together with additional rewards. Students should log-in and reach a certain amount of daily badge quantifier and other conditions for that month. In Figure 44 signifies you as a veteran programmer.

Fig. 44. Sample Proposed Monthly Badge

Proposed formula of weekly and monthly badges

Assuming that there will be three separate meetings weekly for the CMSC128, two lecture series and one laboratory class, the formula for the weekly and monthly badge is shown below. Let *N* be the number of meetings per week, *M* be the number of days required to get a weekly badge and O be the number of days required to get a monthly badge.

Weekly Badge formula: if ((N+1) <= 6) then (M=N+1); else M=N.

Monthly Badge formula: (Should have earned all weekly badges) and O=28-M.

The proposed formula for getting a weekly badge is designed for continuous engagement and awareness of the joined course. The additional one day for weekly is for the encouragement to check the e-learning course for reminders and announcements. The limiter six is to make students have a free day not coercing them to log-in every day. Monthly badges are designed to earn all weekly badges as a pre requisite to chain the engagement. Rewards may or may not be given depending on the teacher.

Systems development life cycle (SDLC)

The developers will be using the Kanban Model to guide them in developing the system. This method is one of the ways that Agile methodology can be implemented (Gurendo, 2015). The development process of the Kanban method is categorized into three different parts: to-do, in-progress, and complete (Powell-Morse, 2017). The to-do category are the tasks that are yet to be worked on. Filling the to-do list can be done along the development phase. The in-progress category is where the list of tasks that are currently been working on by any person in the team. The complete category is where the completed tasks are found.

First the to-do list is initially filled to start the development process. Developers may grab one task in the to-do list and place it in the in-progress list. Note that every task has its own deadline. Any developer currently doing something cannot grab another task in the to-do list. He or she should finish the task on hand first and place it in the completed list before grabbing another new task.

The flexibility of the Kanban Model however does not limit its capabilities to only three categories. Some teams add more categories such as Planned, In Development, and In Testing (Powell-Morse, 2017).

Along with the Kanban Model, the developers also decided to incorporate scrumming in the SDLC. Every meeting, the team produce updates to each of their own in-progress tasks to inform other team members the status of the task. With this combination, the developers can help each other with the task of others when facing difficulty.

Implementation Phase

The system will be implemented in the CMSC 128 class of Asst. Prof. Miguel Guillermo. If the class will have two sections, the researchers will carry out a parallel implementation. In parallel implementation, one of the class sections will be handled with the gamified system while the other will be handled traditionally. By the end of the implementation phase, the final grades of the two sections will be compared to determine any performance growth or difference between the gamified class and the traditional class. The gamified class section will need to answer a survey to determine personal responses and opinions to classroom engagement, motivation, user experience, and learning experience. If the class has only one section, then it alone will be applied with the gamified system. The point of comparison in terms of performance will be based on the past class of CMSC 128 and the current gamified class. Similar to the parallel implementation, the gamified class in this implementation will also need to answer the same surveys.

Testing Phase

The alpha testers and debuggers of the gamified system will be the proponents of the gamification of education study. The target users and beta testers would be the students of University of the Philippines Mindanao specifically enrolled in the course CMSC 128. Since the course will be having two sections, one section would be using the gamified application while the other remains using the traditional learning system.

After the allocated time for the data gathering, the students testing the gamified learning system will be given qualitative surveys in order to measure the motivational factor of badges. Usability survey will be given as well to measure the system's potential and correctness. The performance will be measured through comparing the average grades of the students by the students taking the traditional learning system.

The users of the system will be given different survey questions to ask for the effectiveness of the system. The developers will use System Usability Scale (SUS; see appendix figure 1) and Net Promoter Score (NPS; see appendix figure 2) besides of the questions they have created for the specific modules they have been working on (see appendix tables 1, 2, 3, and 4).

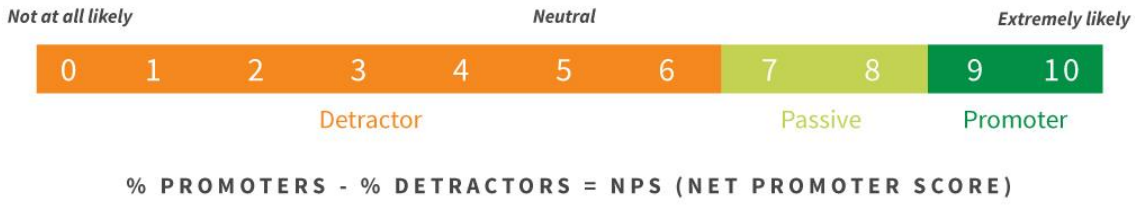

Fig. 45. Net promoter score (NPS) score scale.

Net Promoter Score (NPS)

Net Promoter Score®, or NPS®, measures customer experience and predicts business growth. This proven metric transformed the business world and now provides the core measurement for customer experience management programs the world round (What Is Net Promoter? n.d.).

The NPS calculation

Calculate your NPS using the answer to a key question, using a 0-10 scale: How likely is it that you would recommend [brand] to a friend or colleague?

Respondents are grouped as follows:

1. **Promoters** (score 9-10) are loyal enthusiasts who will keep buying and refer others, fuelling growth.
2. **Passives** (score 7-8) are satisfied but unenthusiastic customers who are vulnerable to competitive offerings.
3. **Detractors** (score 0-6) are unhappy customers who can damage your brand and impede growth through negative word-of-mouth.

Subtracting the percentage of Detractors from the percentage of Promoters yields the Net Promoter Score, which can range from a low of -100 (if every customer is a Detractor) to a high of 100 (if every customer is a Promoter).

System Usability Scale (SUS)

When a SUS is used, participants are asked to score the following 10 items with one of five responses that range from strongly agree to strongly disagree (System Usability Scale n.d.):

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

Interpreting scores

Interpreting scoring can be complex. The participant's scores for each question are converted to a new number, added together and then multiplied by 2.5 to convert the original scores of 0-40 to 0-100. Though the scores are 0-100, these are not percentages and should be considered only in terms of their percentile ranking (System Usability Scale n.d.).

Based on research, a SUS score above a 68 would be considered above average and anything below 68 is below average, however the best way to interpret your results involves "normalizing" the scores to produce a percentile ranking (System Usability Scale n.d.).

Benefits of using a SUS

SUS has become an industry standard, with references in over 1300 articles and publications (System Usability Scale n.d.). The noted benefits of using SUS include that it:

1. Is a very easy scale to administer to participants
2. Can be used on small sample sizes with reliable results
3. Is valid – it can effectively differentiate between usable and unusable systems

Considerations when using a SUS

If you are considering using a SUS, keep the following in mind:

1. The scoring system is somewhat complex
2. There is a temptation, when you look at the scores, since they are on a scale of 0-100, to interpret them as percentages, they are not
3. The best way to interpret your results involves "normalizing" the scores to produce a percentile ranking
4. SUS is not diagnostic - its use is in classifying the ease of use of the site, application or environment being tested

Data Analysis and Results Phase

The gathered data after the implementation phase will be collected and analysed in order to determine if the gamified system has been effective or not. After the data analysis, the data will then be translated in order to derive conclusions and results to be included in the manuscript.

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APPENDICES

Appendix Figure 1. System Usability Scale (SUS) Survey Form (Lifted from Brooke, 1996).

Participant ID: _____ Site: _____ Date: ___/___/___

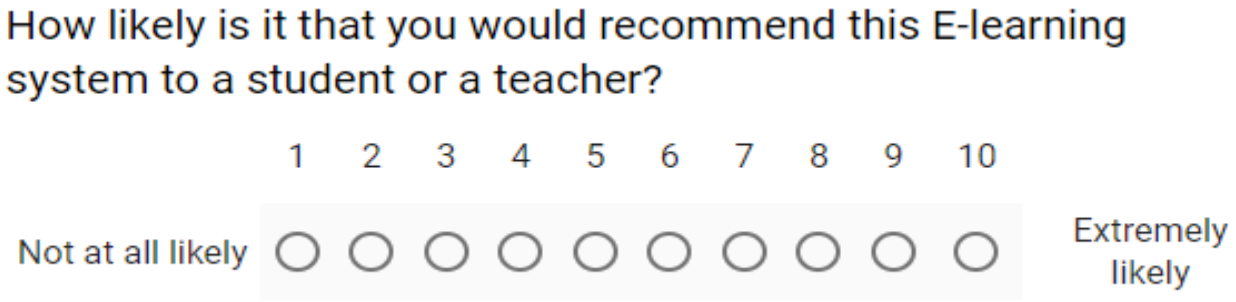
System Usability Scale

Instructions: For each of the following statements, mark one box that best describes your reactions to the website *today*.

		Strongly Disagree				Strongly Agree
1.	I think that I would like to use this website frequently.	☐	☐	☐	☐	☐
2.	I found this website unnecessarily complex.	☐	☐	☐	☐	☐
3.	I thought this website was easy to use.	☐	☐	☐	☐	☐
4.	I think that I would need assistance to be able to use this website.	☐	☐	☐	☐	☐
5.	I found the various functions in this website were well integrated.	☐	☐	☐	☐	☐
6.	I thought there was too much inconsistency in this website.	☐	☐	☐	☐	☐
7.	I would imagine that most people would learn to use this website very quickly.	☐	☐	☐	☐	☐
8.	I found this website very cumbersome/awkward to use.	☐	☐	☐	☐	☐
9.	I felt very confident using this website.	☐	☐	☐	☐	☐
10.	I needed to learn a lot of things before I could get going with this website.	☐	☐	☐	☐	☐

Please provide any comments about this website:

Appendix Figure 2. Net Promoter Score (NPS) Survey Form.



Appendix Table 1. Attributes of the document Users (*users*).

Name	Type	Description
_id	object ID	System-generated primary key.
user_id	string	Desired system identification of the user.
user_fname	string	First name of the user.
user_mname	string	Middle name of the user.
user_lname	string	Last name of the user.
user_birthdate	date	Birthdate of the user.
user_email	string	Email address of the user.
user_password	string	Password of the user.
user_type	string	Type of the user; either a student or a teacher.
user_contact_no	string	Contact number of the user.
user_photo	binary data	Profile photo of the user.
user_security_question	string	Chosen security question of the user.
user_security_answer	string	Answer to the security question of the user.
user_badge_conditions	object	System badge conditions of the user

Appendix Table 2. Attributes of the document Courses (*courses*).

Name	Type	Description
_id	object ID	System-generated primary key.
course_name	string	Name or title of the course.
course_description	string	Description of the course.

Appendix Table 3. Attributes of the document Sections (*sections*).

Name	Type	Description
_id	object ID	System-generated primary key.
course_id	string	ID of the course this section belongs to.

Appendix table 3 continuation.

Name	Type	Description
section_name	string	Name of the section.
instructor	string	Instructor or teacher in charge of the class section.
section_students	array[object]	List of students enrolled in the class section.
section_quests	array[object]	Quests created by the instructor for the class section.
section_items	array[object]	Items created or acquired by the instructor to be used by the students in the class section.
section_badges	array[object]	Badges created or acquired by the instructor to be used by the students in the class section.
schedule	array[string]	Class schedule of the class section.

Appendix Table 4. Attributes of the document Items (*items*).

Name	Type	Description
_id	object ID	System-generated primary key.
item_type	string	Type of the item; either a wearable or a consumable.
item_name	string	Name of the item.
item_photo	binary data	Image file of the item.
item_description	string	Description of the item.
item_hp	integer	Health points that can be acquired with the item.
item_xp	integer	Experience points that can be acquired with the item.
item_ailment	string	Status ailment that can be acquired with the item.

Appendix Table 5. Attributes of the document Quests (*quests*).

Name	Type	Description
_id	object ID	System-generated primary key.
quests_title	string	Name or title of the quest.
quests_description	string	Description or instructions for the quest.
quests_retakable	boolean	Condition if the quest can be retaken or not.
quests_badge	string	Acquired badge upon quest completion.
quests_xp	integer	Acquired experience points upon quest completion.
quests_hp	integer	Acquired health points upon quest completion.
quests_item	string	Acquired item upon quest completion.
quests_start_date	date	Start date when the quest is taken.
quests_end_date	date	End date when the quest is finished.
quests_party	boolean	Condition if students can form a party for the quest or not.

Appendix Table 6. Attributes of the document Badges (*badges*).

Name	Type	Description
_id	object ID	System-generated primary key.
badge_name	string	Name of the badge.
badge_photo	binary data	Image file of the badge.
badge_description	string	Description of the badge.
badge_conditions	object	Conditions that are needed to acquire the badge.

Appendix Table 7. Attributes of the document Posts (*posts*).

Name	Type	Description
_id	object ID	System-generated primary key.
section_id	string	ID of the section the post belongs to.
user_id	string	ID of the user who created the post.
post_content	string	Content or message of the post.
post_comments	array[object]	Contents or messages commented to the post.
post_date	date	Date when the post is created.
commentable	boolean	Condition if the post can be commented or not.
is_post	boolean	Condition to differentiate post and comment.

Appendix Table 8. Attributes of the document Inventory (*inventories*).

Name	Type	Description
_id	object ID	System-generated primary key.
user_id	string	ID of the user the inventory belongs to.
section_id	string	ID of the section the inventory can be accessed by its user.
invemtory_items	array[object]	List of all the items stored in the inventory.
head	string	Equipped wearable item for the head.
right_arm	string	Equipped wearable item for the right arm.
left_arm	string	Equipped wearable item for the left ar.
right_leg	string	Equipped wearable item for the right leg.
left_leg	string	Equipped wearable item for the left leg.

Appendix Table 9. Attributes of the document Files (*files*).

Name	Type	Description
_id	object ID	System-generated primary key.
user_id	string	ID of the user who uploaded the file.
file_name	string	Name of the uploaded file.
file_type	string	Type of the uploaded file.
file_content	binary data	This is the uploaded file.

Appendix Table 10. Attributes of the document Security Questions (*questions*).

Name	Type	Description
_id	object ID	System-generated primary key.
user_security_question	array[string]	List of security questions.

Appendix Table 11. Attributes of the document Experiences (*experiences*).

Name	Type	Description
_id	object ID	System-generated primary key.
user_id	string	ID of the user the experience points belongs to.
section_id	string	ID of the section the experience points is applicable.
total_xp	integer	Total accumulated experience points from completed quests.
quests_taken	array[object]	List of quests completed by the user.

Appendix Table 12. Attributes of the document Party (*parties*).

Name	Type	Description
_id	object ID	System-generated primary key.
users	array[string]	List of users that are part of the party.
quest_id	string	ID of the quest the users are partying for.
section_id	string	ID of the section where the quest and the users belong to.

Appendix Table 13. Survey Form for Badges.

Check the appropriate box for rating the statements.

1 – Strongly disagree 5 – Strongly agrees

Statements	1	2	3	4	5
I am encouraged to go online to the e-learning system to get the daily login badges.					
I get badges that my friends also have because I want to have what they have acquired.					
I want to collect the badges because it makes me feel a sense of achievement.					
I make sure to earn the attainable badge from quests when it is available.					
I want to collect all the badges that are available in the course because I feel the urge to get them all.					

Appendix Table 14. Survey Form for Rewards and Items.

Check the appropriate box for rating the statements.

1 – Strongly disagree 5 – Strongly agrees

Statements	1	2	3	4	5
I take side quests to get consumables.					
I like finishing quests to get the wearable for my character.					
I find it helpful that certain rewards can help me cope up and get more XP.					
The rewards help me get motivated to get more quests.					
I often check the site to check for a new quest.					

Appendix Table 15. Survey Form for Leaderboards.

Check the appropriate box for rating the statements.

1 – Strongly disagree 5 – Strongly agrees

Statements	1	2	3	4	5
I often watch the leaderboard to be updated with rankings.					
I find leaderboard as something that does not motivate me, because I can't get ranks.					
I am motivated to retake a repeatable quest when I just got 2nd in the leaderboards.					
I want to get high scores to always get within the top ranks in leaderboards.					
I want to get the highest score, or fastest submission, to get a rank in the leaderboards.					

Appendix Table 16. Survey Form for Progress Report

Check the appropriate box for rating the statements.

1 – Strongly disagree 5 – Strongly agrees

Statements	1	2	3	4	5
I find it helpful that quests are broken into chunks where I can decide what to do first.					
It helped me learn more when the quests are shown with accomplishment deadlines and due dates at the side bar.					
It helped me decide what path of challenges and quests to undertake and study.					
The progress bars helped me decide and organize activities to take to finish my tasks easily.					
This progress graph does a nice way of giving feedback that gets me motivated as I know my progress.					

BUDGETARY REQUIREMENT

Item	Budget, PHP
Manuscript printing	3,000.00
Proposal printing	500.00
TOTAL	**6,500.00**

SCHEDULE OF ACTIVITIES

Activities	Aug				Sept				Oct				Nov				Dec				Jan				Feb				Mar				Apr				May				Jun			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Proposal Writing									■	■	■	■	■	■	■	■																												
Proposal Defense																	■																											
Execution of Methodology																			■	■	■	■	■	■					■	■	■	■		■	■	■								
Manuscript Writing																																	■	■	■	■								
Final Defense																																												